THE

ELECTRICAL REVIEW.

VOL. XLV. AUGUST 18, 1899. No. 1,134.

CONTENTS:

	PAGE
Electric Tramways in London	257
Indispensable Accessories of Electric Traction (*illustrated*) (*continued*)	260
The Machine Tool Question...	262
Some Notes on the Electrical Machinery at the Como Exhibition (*illustrated*)	263
The "J. & P." Electricity Supply Meter (*illustrated*)	265
The Report of the Pacific Cable Committee (*continued*) ...	267
Ipswich as an Engineering Centre	268
Correspondence:—	
Bankruptcy Proceedings	268
The Telephone Bill	268
Business Notices, &c.	269
A "Fin-de-Siecle" Machine Shop (*illustrated*)	275
City Notes	283
Traffic Receipts	286
Stocks and Shares	286
Share List of Electrical Companies	287
Market Quotations	288
The Municipal Electrical Association:—	
Discussion on Mr. Edgcome's Paper	289
Prof. Kennedy's Report to the London County Council on Mechanical Traction on Tramways	290
A New Wheatstone Bridge (*illustrated*)	292
Light Electric Railways in Middlesex	293
Reviews:—The Value of Electrical Treatment	294
Pocket-book of Useful Formulæ and Memoranda	294
New Patents	295
Abstracts of Published Specifications	295

THE

UNIVERSAL ELECTRICAL DIRECTORY

1899

Edition

Price 6s.

NOW READY.

H. ALABASTER, GATEHOUSE & CO.,

4, LUDGATE HILL, LONDON, E.C.

THE ELECTRICAL REVIEW.

Published every FRIDAY Price 4d.

The Oldest Weekly Electrical Paper. Established 1872.

TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

OFFICE:—4, LUDGATE HILL, LONDON.

Telegraphic Address: "AGENRAY, LONDON." Code A B C.

Telephone No. 988 Holborn.

ALL Letters should be addressed to the Proprietors, H. Alabaster, Gatehouse & Co.

ADVERTISEMENT RATES ON APPLICATION.

The "Electrical Review" is the recognised medium of the Electrical Trades.

SUBSCRIPTION RATES.—In *Great Britain*, Post Free per Year, 19s. 6d. To *all other countries*, per Year, £1 10s.

BINDING.—Subscribers' numbers bound, including case, for 4s. each volume.

CASES.—Cloth Cases for Binding can be had, price 2s. 6d. each.

READING CASES, to hold from One to Twenty-six Numbers until the Volume is complete for Binding, can now be had from the Publishers, Price 6s. or Free by Post (in Great Britain), 6s. 6d

FOREIGN AGENTS.—New York: D. VAN NOSTRAND, 23, Murray Street. *Paris:* VEUVE J. BOYVEAU 22, Rue de la Banque. *Berlin:* ASHER & Co., 13, Unter den Linden.

Cheques and Postal Orders (on Chief Office London, to be made payable to Mr H. ALABASTER, 4, Ludgate Hill, E.C.

ELECTRIC TRAMWAYS IN LONDON.

IT is but repeating an oft-told tale to mention that in many matters affecting the welfare, the comfort, and the convenience of the inhabitants, London occupies an inferior position to many, if not most, provincial cities. Not only are the arrangements of intercommunication lamentably old-fashioned, but the lighting of streets and open spaces is neglected to a remarkable degree, and it is not surprising that it should be held up to ridicule by intelligent foreigners. In an American city of moderate importance a swift electric tramway service provides the most popular mode of progression; in London, where walking is impossible, the traveller must use the slow and lumbering omnibus or endure the rapaciousness of a cab driver. There are, however, signs of an improved state of things so far as systems of locomotion are concerned; the districts of West London are likely to receive the benefits of an electric tramway service within a reasonable period, and even the London County Council is prepared to modify the views which it formerly held, and give us a system of electrically operated lines. Some time ago Prof. Kennedy was commissioned to prepare a report on the subject, and in many respects the report which he has presented to the London County Council is of the greatest importance. It is, in the first place, one of the few reports on electric traction prepared by an eminent English consulting engineer for a local governing body, and for that reason alone the conclusions which he has given should be weighed with the greatest care. For the purpose of arriving at a just appreciation of the various systems of electric tramways at present in use, Professor Kennedy has paid visits to the Continent and to America, and doubtless the information which he has obtained is of the greatest value. It is not proposed to make any extended reference or quotation from the report, for we print it full in our other columns. But in order that our comments may be appreciated at their true worth, it will be necessary to make an occasional reference to some of the statements which are put forward. The systems upon which the Professor has reported, comprise the use of gas, compressed air, and electricity. Most of our readers will probably share Prof. Kennedy's convictions that gas and compressed air cars possess unmistakable advantages in being self-contained, and independent of a central source of power. In this, however, they share their advantages with accumulator cars, but just as we should expect the exercise of caution in recommending the latter form of traction, so are we not surprised to learn that Professor Kennedy does not recommend either gas or compressed air, for the reason that there is not sufficient experience of compressed air traction, and gas traction is for the present put out of court by the difficulty in obtaining really suitable engines. Having, therefore, dismissed these systems as not possessing sufficient merit to be entertained by the London County Council, Professor Kennedy comes to consider the use of electricity.

No one could deny that the four systems of electricity, the overhead, the conduit, the surface contact, and accumulator systems have been carefully gone into. But a most casual perusal of the report soon convinces one that in the Professor's estimation the overhead wire system is practically unsuited to the condition of the central London streets, although for thoroughfares that approach the suburbs Prof. Kennedy is not averse to overhead wires. Coming after the completion of so many important schemes involving the use of overhead wires, the conclusions of Prof. Kennedy are, to say the least, somewhat startling, and it is necessary to carefully consider the whole position of electric tramways in this country, because the proposals of the County Council are watched with the greatest interest by many municipalities, and doubtless the system they adopt will be copied to some considerable extent. It will be admitted that the importance of the County Council's proposals are lessened by the fact that great municipalities, whose work is not one whit less useful than that of the County Council, have already embarked upon overhead wire schemes. In speaking of the overhead wire system, Prof. Kennedy states that when carried out as roughly as it has been carried out in America its cost is very much less than that of any underground system, but carried out as it is necessary to carry out a system in this country the difference of cost is not nearly so great. It will be necessary to refer to this point subsequently, but when it is stated that for this reason the overhead system has naturally commended itself to private tramway companies and also to municipalities in comparatively small towns, one feels constrained to point out that the overhead wire system, where adopted by municipalities, is not in small towns but in the great towns, Liverpool, Manchester, Glasgow, &c. In any one of these cities it can be confidently stated that the tramway systems are equal to, if not in some respects larger than that at present controlled by the County Council. There are probably many engineers who will be inclined to agree with the view that the overhead wires cannot be regarded as likely to prove a permanent and final solution of the traction problem in a great city like London. Admitting that, however, it must not be forgotten that some system may arise which will do away with the necessity of using overhead wires, and that such a system may also render obsolete both the conduit and the present forms of surface contacts. As Prof. Kennedy points out, crossings and street junctions on the trolley system do involve a little complication in overhead wires, but there are many instances in this country where the overhead wire work is of such a description that very little objection can be urged against it. Moreover, much of the complication which at present arises at such places is greatly enhanced by the use of guard wires. Guard wires for the most part, especially in large cities, are necessary to give protection to the telephone system, but the National Telephone Company which owns the whole of the town overhead telephone wires of the country is gradually putting its overhead net-work underground, consequently in a few years' time the necessity for employing guard wires may cease to exist. Moreover, if even telephone and telegraph wires were always to remain in contiguity to the tramway wires, we feel confident that some method would be evolved to obviate the use of somewhat unsightly guard wires. Professor Kennedy makes the statement that "If any private company asked permission from a committee of the London County Council to erect at any one of the 12 junctions, such arrangements of poles, span wires, stays, guys, conductors, &c., the proposal would be met by an absolute and unconditional negative." It is quite probable that Prof. Kennedy is right on this point, and we firmly believe that the County Council would refuse permission. In raising these objections to the overhead trolley system, it is obvious that Prof. Kennedy is paving the way to the suggestion of a conduit system; and it may be said that the chief part of his report is devoted to establishing the claims of an underground conduit or slot system. The Professor states: "I am glad, therefore, to be able to say as the result of my examination of the present state of underground electric tramways, that the laying out and working of lines on the slot system has already been carried out successfully on a very large scale." No one seeks to deny for a moment the conspicuous and well-deserved success that has followed the introduction in some places of an underground conduit. But there ought to be a clear and unmistakable understanding on the part of all persons engaged in considering the problems of electrical traction that the underground system has been only adopted where it has been made compulsory. The authorities that control the roads of our cities have perfect and free right to prevent what may be held as spoliation, but it must not be forgotten that in this country tramways will be for the most part operated and controlled by municipal bodies, and naturally, whether they carry out the system themselves or permit it to be carried out by a company, their concern for the appearance of the public thoroughfares is the same, and admitting that, what do we find? Nothing less than the wholesale adoption of the overhead wire system by the various large towns of the country. And lest there should be any misunderstanding on this point, we want to show that the great scheme of the London County Council is not the only one in the country; it is probable that the tramway system to be converted to electric working will comprise some 200 miles of single track and 500 cars, but the Glasgow Corporation have already decided to adopt a system taking 600 cars as a basis and with a mileage that will be probably greater than that of London. The Corporation of Manchester is at present engaged on a scheme that is of much more importance than that of the London County Council, Liverpool is going ahead with a large scheme, and these municipal authorities have considered that the overhead wire system is the only one to adopt. We have a certain amount of belief in a conduit system, and there is no doubt that from a working point of view it is quite as practicable as an overhead wire system. It may cost a little more to operate on account of the larger maintenance charges, but there is no shadow of doubt that such a system can be really considered on a practical basis. It must not be lost sight of, however, that a conduit system means a very serious increase in capital expenditure. If a local authority is prepared to pay for such a system it must be clearly understood that it will give no better working, and will be, moreover, open to certain drawbacks. Prof. Kennedy lays considerable stress upon the fact that the chief engineer of one of the principal companies using both systems gave as his experience, that where the overhead system has to be provided with underground feeders and with handsome poles and other appurtenances as would meet with the approval of his municipality, the actual difference in cost between the two systems was very inconsiderable. It is necessary that fuller information should accompany such a statement, because it has been fully recognised by engineers who have carefully considered this matter that there is a very considerable difference between the cost of

constructing an underground conduit and the overhead wire system, even where the overhead work has been of the very best type. One of the most notable instances of the conduit system is that of New York, and there is very little doubt that the commercial success achieved by this line has been due to the splendid way in which the conduit was built, which, moreover, cost as much as £20,000 per mile. It is interesting to quote from our issue of December 2nd, 1898, when we made some reference to the New York conduit system. We said then: "Supposing that the entire Metropolitan system of 210 miles should have been equipped on the best overhead system, instead of the conduit, a saving of 2½ to 3 million pounds sterling in the capital expenditure would have been effected." We further stated that it must not be overlooked that the construction of a conduit, besides at least doubling the total capital expenditure, entails an enormous amount of annoyance to a city during its construction, as the people of Brussels, New York, and Berlin now know to their cost. Before leaving this phase of the subject we would call attention to the views expressed by an expert of undoubted eminence in electric traction, and the opinions put forward by this engineer are especially interesting, because the New York conduit line, about which we have heard so much, was designed and carried out by him. We are referring to Mr. Pearson, who was called in by the Liverpool Corporation to advise on the subject of traction. At that time the municipality of Liverpool were in doubt as to the best system to adopt; but the opinion put forward by Mr. Pearson was clear and emphatic on this subject. He stated in his report to that municipality that "the cost of construction of the slotted conduit is very much greater than that of the overhead trolley, as it is necessary to build the conduit in a very substantial manner, in order to withstand the heavy trucking and the effects of frost, which tend to close the slot and disarrange the conduit."

One advantage possessed by the overhead wire system is, one pole will frequently serve to carry wires for two tracks; but with the conduit each track means a separate conduit, and this affects cost of construction in a most striking manner. Taking Mr. Pearson's estimate for Liverpool, we find that one mile of straight track for overhead trolley would cost £5,822, and one mile of straight track slotted conduit system £9,648. If we were to take these as a basis and apply them to the 200 miles of track in London, a conduit system for track alone would cost the County Council £1,929,600, against £1,164,400 for the overhead. In other words, they would pay £765,200 for the luxury of working tramways without overhead wires. We are quite aware that it is not proposed to apply the conduit throughout, still these figures serve to show how enormously the expenses increase over a large system. Very probably Prof. Kennedy has had in view the permanence of the system, but one may pay too high a price even for permanence. In considering electric tramways, we do not suppose there is a single municipality that has not been at the beginning prejudiced against overhead wires. The report of the Glasgow deputation states that "we started our investigations more or less in sympathy with this objection (to overhead wires), but we are bound to say that what we have seen has quite removed from our minds any objection to the overhead wires. Where the system is carried out in the most approved manner, we found that the wires gave only the very slightest offence." But even if the good citizens of Glasgow had prevented the introduction of the overhead system, they would have been completely debarred from using a conduit system, for on one of the principal routes the surface of the street is within 12½ inches, and at other places the arch of a bridge was only 4½ inches from the street surface; it will be seen that under those conditions concrete below the central conduit to a depth of 2 feet is quite out of the question. Is London in any better position than Glasgow in this respect? There may not be many bridges to cross, but the amazing ramification of pipe work within a few inches of the street surface should give pause to any conduit scheme. Why, the very section on which the County Council proposed to try the conduit system is declared by Prof. Kennedy to be unsuited, because along this route there are "three 30-inch water mains at no very great depth below ground." But if Prof. Kennedy and the Council is convinced that the electric conduit is the right thing, why try experiments? We know that the conduit can be made to work, and surely it is hardly necessary to acquire information as to management. Moreover, an experiment is being already carried out for the benefit of the London County Council, but at the expense of the London United Tramways Company. There is another point on which we should like to lay special emphasis. The Professor says: "While admitting to the fullest extent that for a company whose business is to earn dividends for its shareholders the overhead system will appear the most advisable, and while admitting also that for small towns where the traffic cannot be anything like as much as, and where the expenditure may be proportionately much larger than in London, it may be desirable, on public grounds, to limit the expenditure to the lowest possible amount, yet in the case of London itself I submit that these considerations have not such weight." Our contention is that it is not the small towns which have adopted electric tramways, but the large ones. It must be admitted that the central portions of Liverpool and Manchester are almost as crowded as London, yet we find that the Liverpool Corporation, after a deputation had inspected the European conduit systems, reject the conduit because it "is unsuitable for Liverpool tramways with their heavy and crowded traffic"; they share with the Sheffield municipality the view that complicated tramway crossings would entail considerable constructive difficulties, the system is expensive to maintain, and liable to interruption; that in case of breakdown the difficulty of access causes serious delays; moreover, the Liverpool Corporation states that from a sanitary point of view an open conduit which cannot be effectively cleansed is objectionable. The Belfast Corporation are possessed of a praiseworthy desire to preserve intact the beauty of their streets, yet a committee declares that "the difficulties that would be encountered in introducing an underground conduit system in the lower portions of Belfast, having regard to the position of sewers, covered river courses, gas and water mains, the relation of street surfaces to high water level, and the necessarily wide groove required in the rails, are so great that the deputation cannot recommend its adoption." The people of London are long-suffering, but it is to be feared that even their patience would be exhausted during the period of constructing an underground conduit. In this respect, the inconvenience of constructing a conduit in Berlin has been so great that though the Berlin police authorities will not permit overhead apparatus in the centre of the city, it was some time ago decided not to allow the construction of any more conduit lines on account of the inconvenience arising during construction. It will be seen that the objections to conduits are very real and very serious. They are not insurmountable, but the removal of the difficulties demands a price.

Prof. Kennedy does little more than mention the surface contact and the accumulator, though he foreshadows the possibility of the former system being brought to a practical state. Whatever system of electric tramways is introduced into London, we shall rejoice to see it. We may, however, point out that the L.C.C. is not likely to err on the side of economy.

D

INDISPENSABLE ACCESSORIES OF ELECTRIC TRACTION.

By HENRY E. P. COTTRELL, A.M.I.C.E.

(*Continued from page* 214.)

Lighting Couplings.

The chief requisites in lighting couplings are simplicity and reliability. Fig. 63 shows a simple and effective form of plug connection for trailer car lighting designed by Messrs. R. W. Blackwell & Co. The holder is fastened below the floor of the balcony ends of the main car, and consists of a socketed brass projection in which the lighting cables end. The trailer lighting cables terminate in a plug of ebonite tapering into a brass holder. To couple up the two the trailer plug is inserted into the socket of the fixed projection

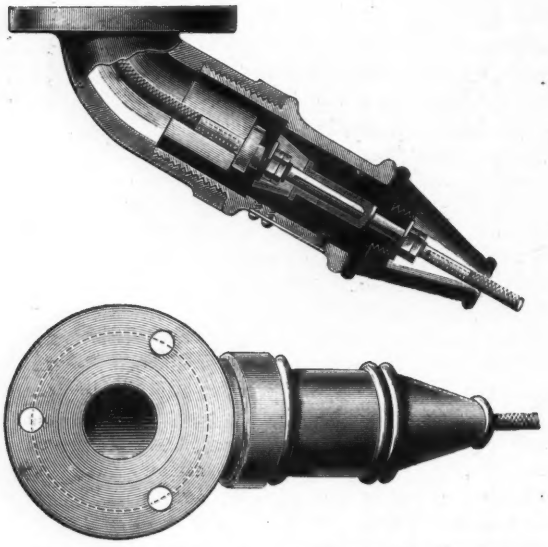


Fig. 63.—Plug Connection for Trailer Car Lighting.

on the main car, the central hollow projection in the socket running into the socket of the plug and receiving the central rod, thus doubly establishing the required connection. This form of coupling is very generally adopted, and fulfils the requisites mentioned above very satisfactorily.

Commutator Segments and Carbon Brushes.

As accessories only are being dealt with in this series of articles, there are only two connected with the motors which will be critically examined; the first are commutator segments, the second commutator brushes. To obtain the standard of thorough efficiency it is most important that commutator segments should be made from metal which is absolutely uniform in texture and fibre throughout, otherwise the flow of the current is interrupted and irregular, heating is generated locally, power is lost, and the segments are more rapidly worn out than they should be. Cast copper even when compressed by stamping is very far from uniform in texture and fibre, and is therefore not satisfactory as a material for commutator segments. These should be forged from drawn rods of wrought copper. The accompanying figs. (64A and 64B) show the operation of breaking down and striking up a forged rod to produce a Westinghouse commutator segment, and figs. 64C and 65 show a T.H.W.P. and an S.C. Westinghouse finished segment, respectively, produced by the drop forging process, which are absolutely free from the imperfections of cast segments, such as porosity, blow-holes, &c. The process consists in forging hot, pickling to remove all oxides, trimming to remove the flash of fin, and finally hitting them a heavy blow when cold, between hardened and accurately gauged dies, to increase the density and impart smooth surface and correct taper and finish.

BILLINGS' PATENT (DROP-FORGED) COMMUTATOR SEGMENTS.

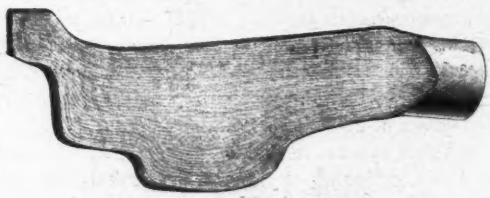


Fig. 64A.—"Breaking Down" Operation.

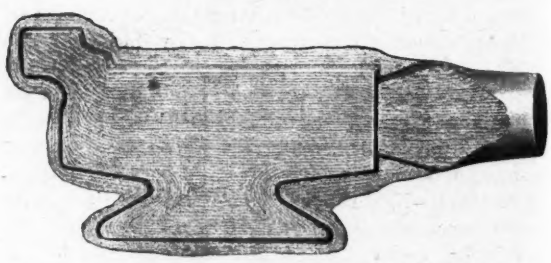


Fig. 64B.—"Striking Up" Operation. S.C. Westinghouse Bar 95 Div.

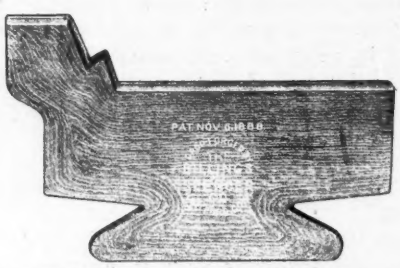


Fig. 64C.—S.C. Westinghouse Bar, 95 Div., Weight 7¾ oz.

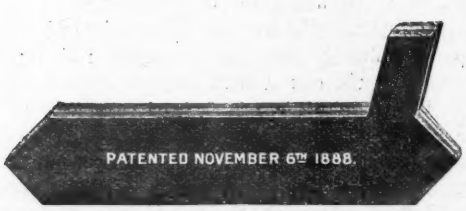


Fig. 65.—T.H.W.P. 30 Bar 64 Div., Weight 6 oz.

Brushes.

In all motors used on electric cars where the motion has to be reversed in direction, the commutator brushes cannot be constructed of copper, the most satisfactory material in

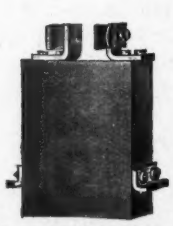


Fig. 66.—Fuse Block.

this case is found to be carbon in certain forms. Carbon in an ordinary way is full of gases and porosities and is therefore wholly unsuitable for the purpose, as it inevitably produces cutting and sparking, both of which materially

diminish the life of the commutator as well as the brushes themselves. It is, therefore, essential that the carbon of which the brushes are made should, like the metal of the commutator segments, be uniform in texture and fibre throughout. Furthermore, the brushes should be self-lubricating without being greasy and without clogging or gumming at the tips. The ordinary self-lubricating carbon brush is deficient in all these respects, and although cheap in first cost has a very short and troublesome life and is injurious to the commutator in more ways than one. There is, however, a patent process for producing carbon brushes

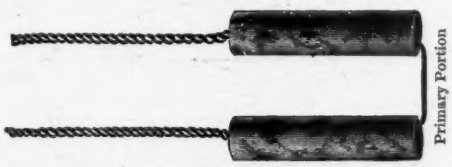


Fig. 67.—Protected Terminal Fuse.

that are free from these drawbacks; by this process the gases contained in the carbon blocks are first extracted, and then the voids are filled by forcing in a special compound, which is a natural lubricant, without being either greasy or oily. This special compound increases the conductivity of the brush and diminishes the specific resistance of the carbon, thus insuring better contact and smaller percentage of loss in the current conveyed, so that the brush is from 7° to 10° cooler than other types of brushes, the life of both commutator and brushes being thus enormously increased. The brushes wear smooth as velvet, and have no tendency to to crumble or break, they require little or no attention, while the commutator is kept constantly lubricated without gumming the segment tips. The compact and uniform texture

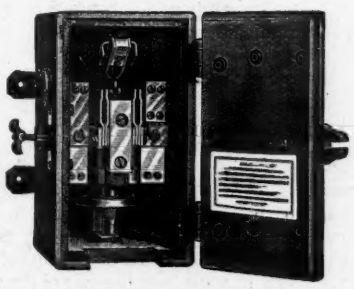


Fig. 68A.—I-T-E Car Circuit Breaker.—Sill Type.

of the surface of these brushes admit of their being plated with either copper or silver, and thus of acquiring the maximum conductivity. The trade name by which they are known is the Le Valley Vitæ Carbon Brush.

Car Circuit Breakers.

The very severe conditions under which the various portions of the equipment of electric tramway cars have to work demand other and more adequate protection than that afforded by fuses. The fuse limits are, in practice, fixed much higher than experience shows is desirable to provide for the jumps in the current which the motors are expected to momentarily sustain. The consequence is, when a short circuit occurs or heavy ground is encountered, the fuse permits dangerously heavy currents to pass without even blowing, and much mischief may ensue unchecked. On the other hand, it often happens that with a heavy load or while ascending a steep gradient, the fuse may blow when it is neither expected nor required to do so; both these drawbacks can be remedied by the substitution of a circuit breaker for an ordinary fuse, and the former to be effective must comply with the following requirements:—

1. They must counteract the careless treatment and abuse of equipment on the part of incompetent or reckless motormen.

Fig. 68B.—I-T-E Car Circuit Breaker.—Dashboard Type.

2. They must prevent interference with travel and stoppage of service arising from the power station circuit breakers being brought into action through the breaking down of an individual car.

3. They must put a stop to the arcing set up by the sluggishness in blowing of a heavy fuse when ground or short circuit occurs, and the consequent destruction of surrounding material and insulation.

4. They must avoid the development of new faults and flaws in the apparatus during short circuits or ground, contingent on the abnormal carrying capacity of the fuses employed.

5. They must put an end to all burning and blistering of contacts when circuit breakers open.

6. Their adjustment must be independent of friction springs or other fittings liable to alteration, and when adjusted, they must not be able to be altered without the knowledge of the superintendent of equipment.

To ensure the above characteristics, the car circuit breaker must be provided with a fuse block composed of practically indestructible material, connected with a diminutive protected terminal fuse, whose carrying capacity is a small fraction of the lowest adjustment of the instrument. This fuse must be connected in shunt with the circuit breaker contacts so as to blow immediately on the circuit breaker opening, and must be readily replaceable. A record of terminal fuses

Fig. 69.—"Ajax" Arrester.

expended by each motor man provides a ready check on abuse of equipment, as when a car is properly operated, the necessity for and consequent probability of the contact breaker being opened is reduced to a minimum.

Figs. 66 and 67 show an indestructible fuse block and a convenient form of protected terminal fuse, and figs. 68A and 68B two forms of I.T.E. car circuit breakers, one for fixing on the sill, and the other on the dashboard of a car, which satisfactorily comply with the requirements set forth above.

Lightning Arresters.

The destructive passage of currents of very high voltage may also be induced through the connections of a motor car, with all the undesirable consequences detailed above, by the action of lightning, and here the circuit breakers would be inoperative, and a special appliance known as a lightning arrester has to be provided. To be efficient a lightning arrester must be extremely sensitive, and must not be liable

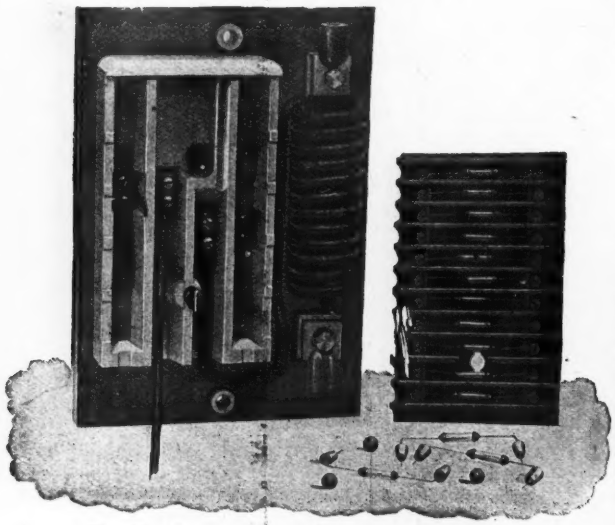


Fig. 70.—Isolated Plant Lightning Arrester.

to getting out of order by contact with dust or damp. Fig. 69 shows a form of fuse (the "Ajax") specially adapted for lightning arrester construction. This consists of two pieces of No. 26 brass wire, each 3 inches in length, having a single silk insulation. These are laid side by side for about 1 inch, as in consecutive armature coils. This lap offers

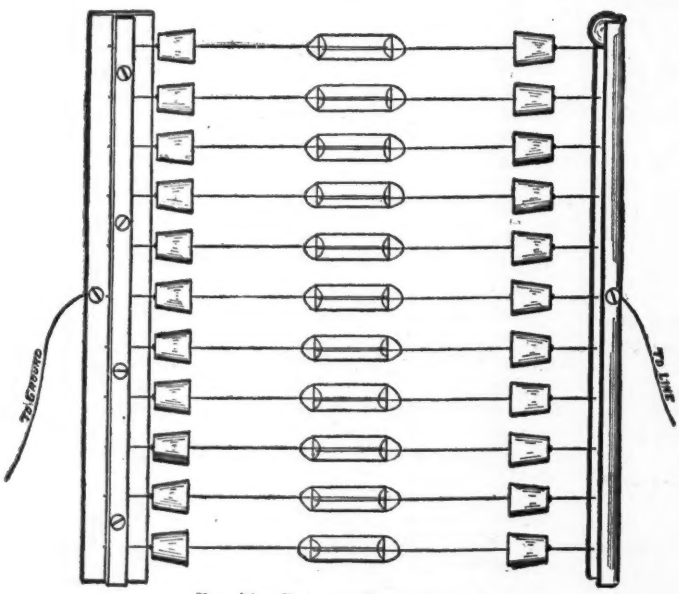


Fig. 71.—Plan of Construction.

abundant surface for the discharge gap which is formed by the two thicknesses of silk amounting to little more than ·002 of an inch. The wires are secured in position by small pellets of highly-insulating wax, and a small glass tube is hermetically sealed over this part of the fuse to keep the dischargers dry and clean till used. Extreme sensitiveness in this part of the fuse is rendered possible by its being called upon to act but once. The ends of the wires are passed through soft rubber plugs, which serve to hold the fuses in the corrugated cover of the arrester (see figs. 69 and 70), and the bare ends projecting through the cover are connected with the line and ground terminals as shown in fig. 71. The fuse frame is fixed on a marble slab, $7\frac{3}{4}$ inches × 11 inches × $\frac{3}{8}$ inch, with an inductance coil in parallel, the latter being connected through the switchboard with the motor and through that to ground.

The adoption of efficient circuit breakers and lightning arresters, such as are above described, reduces the risk of breakdowns due to burned armatures, scorched contacts, and destroyed insulation to infinitesimal proportions, and thus ensures the non-interruption of service so much appreciated by the public.

(*To be continued.*)

THE MACHINE TOOL QUESTION.

In our issue of August 4th we completed a *précis* of an able paper on "Machine Tools," read by Mr. Amos before the Society of Engineers. That the author has bestowed a large share of attention to the subject is clearly shown by the comprehensive and thorough nature of the paper. The machine tool question is assuming dimensions so extended as to render it almost impossible for one mind to possess a detailed grasp of it; much more difficult is it for one firm to do justice to more than a comparatively small section of the industry. The Americans have more fully realised this cardinal truth than the manufacturers on this side, and have as a consequence excelled in their wares, and have thereby provided us food for serious contemplation. Their policy consists of putting into force the well-worn apothegm, "'Tis better to do one thing well than many things badly." This is undoubtedly a great factor in the success of our country cousins. Another factor has been the very high cost of labour prevailing in the States; this has stimulated invention to an enormous extent in reducing hand labour to a minimum and encouraging by convenient arrangements the instant alteration of feed, to deal with changes in the diameter of work. To minimise the time of manipulation the handles controlling the various motions are all brought under the hand of the operator.

An important factor in this tool question, and one which is frequently overlooked, is the miserable want of facilities that English makers have of becoming acquainted with each other's manufactures. A similar difficulty presents itself to the purchasers, whose knowledge of tool makers and types of tools is frequently of the most limited character. This state of affairs is partially due to the jealous manner in which the manufacturers sentinel their workshops against each other, but more largely due, perhaps, to the absence of a journal devoted exclusively to machine tools and manufacture. America has at least two excellent papers of this character, notably *The American Machinist* and *Machinery*. These publications bristle with practical matter by practical men, and it behoves every English manufacturer to include both of them in his literary pabulum.

Added to these elements of advantage must be considered the difference in character of the two nations. We are ponderous and lethargic, while our "cousins" are versatile and energetic. Our brains are probably equal to those of the Americans, but whilst we are considering our ideas the latter go ahead and give effect to theirs. They may make more mistakes, but they "get there" sooner.

The great cry of English makers against the lightness of American tools has now been silenced, with one little exception, which is still adhered to with extraordinary pertinacity. We refer to the tool post, which, in the American design, is a paltry little pillar, with a single screw to secure the tool. The fact of its being so universal in America makes one inclined to think that prejudice has something to do with its disfavour in this country.

Whilst fully recognising the impossibility of describing every tool in the market, we feel that there are omissions of one or two tools of sufficient importance to justify our mentioning them without apology to the author of the paper. Among these is a type of large and heavy tools known as "portable tools," which are almost indispensable adjuncts in electrical factories where big units are produced. For the employment of these machines a large cast-iron bed is provided and permanently fixed, the surface being cut up by slots in all directions, and upon this is clamped the work to be dealt with. Various self-contained electrically driven tools, such as slotters, millers, or drillers, are carried about by an electric crane to the required site and put to work; in some cases several tools may be employed simultaneously. Newton, of Philadelphia, among others, makes a specialty of this class of machine.

Another excellent portable tool, chiefly used for engine work, is a planing and slotting machine, by Morton, of Muskegur Heights.

Portable tools may be considered an apt illustration of the mountain coming to Mahomet.

In mentioning automatic screw machines, the Cleveland should not be omitted, it being perhaps the most up-to-date of its class, the time of changing from one size of screw to another being reduced to a minimum by the replacement of the cam plates by a simple screw adjustment.

Mr. Brockie (of arc lamp fame) is now putting on to the market a very wonderful machine of the automatic character and of very simple construction.

In connection with the automatic tools, we are surprised that no reference has been made to the semi-automatic lathe of Gisholt. It is rapidly becoming a necessity in this country for repetition turning and boring work. The exact dimensions are obtained very simply without callipering, by means of adjustable screw stops.

The multiple spindle drilling machine for producing holes not all in a line is a most remunerative labour-saving device. The drills can be set in any position within the capacity of the machine and locked immediately, the motion being conveyed to the spindles by "Hook's" joints.

Reference should be made to the "hogging" machine of Ingersoll, the principal feature of which is the cutter, which consists of a cylinder with a number of circular cutters projecting like the bristles of a "hog." It is not clear whether the name is derived from the position of its cutters or from the fact that it "hogs" off the work.

Talking of cutters brings home the importance of tool grinders generally, and there is absolutely none to hold a candle to that of Sellers, which is the prototype of the Gisholt.

The draw shaper is, perhaps, a type of tool known too well to require description.

In the way of "special tools" the 4-spindle boring machine of Newton's is well worth consideration. By its use the four journals are bored simultaneously by four independent boring heads with 6-inch spindles. This arrangement obviates a boring bar and its contingent spring.

With regard to the question of motor attachments one cannot feel very proud of Muir's drill, which does not give one the impression of being more than an afterthought.

In conclusion, the industry is certainly indebted to Mr. Amos for directing its attention in so able a manner to a subject of so much importance; he strongly recommends that all English engineers before purchasing tools to any extent should cross the "herring pond" and see these wonders for themselves.

SOME NOTES ON THE ELECTRICAL MACHINERY AT THE COMO EXHIBITION.

By KENELM EDGCUMBE, Assoc.M.Inst.C.E.

Although the Como Exhibition has been completely destroyed by the disastrous fire of a few weeks ago, some notes on the more important electrical engineering exhibits which it contained, may perhaps be of interest. With the exception of two or three German firms, all the heavy machinery exhibited was of Italian make, and possessing few features of actual novelty, was, perhaps, chiefly of interest as indicating the present tendency of "Continental" design. For although the conditions obtaining in the various European countries obviously differ enormously from one another, yet there is far greater similarity observable between machines built in Italy and Sweden, for example, than between those produced by two such near neighbours as Great Britain and, say, Belgium.

Whatever may be the cause of this state of affairs—and probably the difference in the ratio of cost of material to cost of labour has much to do with it—any such collection of Continental machines possesses a peculiar interest for British engineers.

In a general way, the most noticeable features are (1) the well-nigh universal use of carbon brushes (and the extremely simple and compact brush-holders used therewith). (2) The almost entire absence of the ordinary upright two-pole horse-shoe magnet. The majority of the smaller machines are of the ironclad type, often with a pair of virtual poles, thus forming a four-pole system. (3) The various devices in use to prevent sparking with slotted armatures. In this connection it may be noted that the Allgemeine Elektricitäts-Gesellschaft appears to be abandoning the Dobrowolski cast-iron pole bushing, except for quite small motors, in favour of the Schuckert skew cut horns. The most usual device, however, and one which has probably been adopted from American practice, is merely to cut down the pole tips so as to concentrate the field by lengthening the air gap under the horns. (4) It may be remarked that in nearly all cases marble is used for switchboards instead of slate. This is partly because the former is inexpensive in Italy, and partly owing to the fact that much of the slate contains veins of metal, and is therefore unreliable for this purpose. It is becoming the almost universal practice to employ an iron frame-work for the panels.

Fig. 1.

Coming now to the actual exhibits. Among those of the Italian firms, perhaps the most interesting display was that of Messrs. Brioschi, Finzi & Co., of Milan. They showed a three-phase inductor alternator of a type which they have constructed for some 12 months with great success, and which presents some interesting features. Fig. 1 shows this machine. The output is 150 kw. at 900 volts. As will be seen from the figure, the field winding is not only fixed, but is wound in slots on the same laminated core as the armature winding. In the particular machine under consideration, the inner and outer sets of coils form the field, while the armature coils, which are of the ordinary type, are "sandwiched" in between them, thus reducing magnetic leakage to a minimum, though of course making efficient insulation more difficult at high voltages. It will be readily seen that as the six laminated poles revolve, the permeance

changes in such a way as to cause the field to rotate, and in so doing to cut the armature conductors. These machines, which are said to come out slightly more expensive than those with revolving magnet coils, have the great advantage of enabling the armature and field coils to be replaced with the greatest ease, and without its being necessary to remove the magnets.

Fig. 2 shows in longitudinal section a 200 KW. single-phase alternator with magnetic clutch, built by the same firm. As will be gathered from the figure, the exciting coil

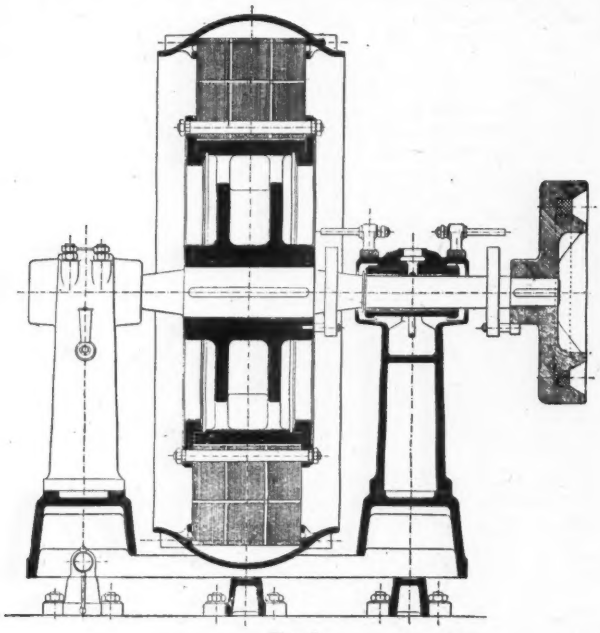


FIG. 2.

of the clutch is in series with the field coils, the current being conveyed to the rotating part by two slip-rings. On test this machine gave the following results:—With a non-inductive load, the full load efficiency was 93 per cent., and the drop in volts, from no load to full load, was 6·5 per cent., the full load voltage being 400. With a load having a power factor of ·8 the efficiency fell to 92 per cent. and the

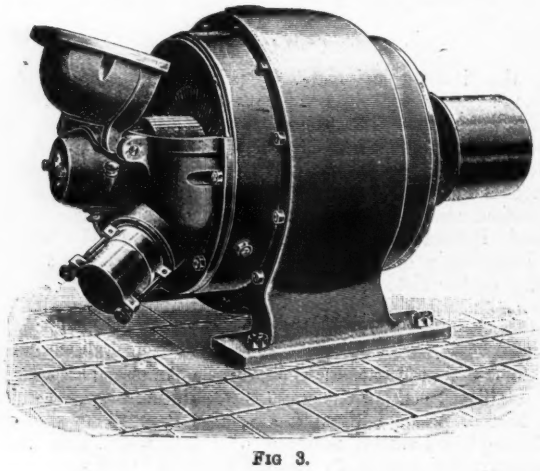


FIG 3.

drop was 25 per cent. The short circuit current proved to be 1,450 amperes, or about three times the normal.

This firm makes a speciality of small motors for driving various classes of machinery, but more especially that used in the silk industry, for which Northern Italy is so famous. For this purpose the motors used are chiefly of the enclosed or semi-enclosed type. Fig. 3 shows a four-pole enclosed continuous current motor of 4 H.P. When the lid is down the motor is hermetically sealed in. The chief peculiarity of this motor is that the entire magnetic circuit consists of laminated iron—not so much to eliminate eddy currents in the poles as to reduce the cross field due to armature reaction. For this purpose the laminations must, of course, be parallel to the armature spindle, thereby offering a greatly increased magnetic resistance to the cross field. The armature, which is slotted, is wound with Eickemeyer coils, held in place by bands. The efficiency of this motor is 85 per cent. at full load. There is also a three-phase 2-H P. motor, arranged for driving a lathe. The speed is reduced to 200 revolutions per minute by gearing fixed to the motor body. This gearing, which consists of a raw-hide pinion driving a cast-iron spur-wheel, has an efficiency of 95 per cent. That of the motor is 79 per cent., so that

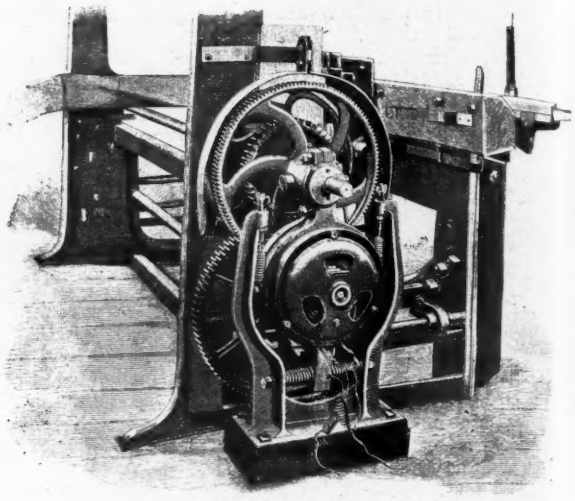


FIG. 4.

the combined efficiency reaches 75 per cent. at full load. The motor is so pivoted that its weight is partially supported by the driving belt, thus securing an even tension on the latter.

In the case of motors driving textile machinery through intermediate gearing, it is usual to support the motor on springs, so as to avoid all shocks. Fig. 4 shows such an arrangement applied to a three-phase motor. The motor body is so suspended as to be capable of swinging about the

FIG. 5.

axle of the driven machine, its weight being carried by the two vertical spiral springs. In order to keep the motor in position two horizontal springs are applied, one on each side, to an extension of the under side of the case, as will be seen from the figure. By the simple expedient of hanging the motor slightly eccentrically, the distance from centre to centre of driver and driven can be easily adjusted.

The most noticeable feature about the enclosed motors built by this firm is that the outer surface of the case is pro-

vided with a series of ribs, which serve the double purpose of strengthening the construction, and of increasing very greatly the cooling surface. In the 1 H.P. motor the surface is nearly 40 per cent. greater than that of the

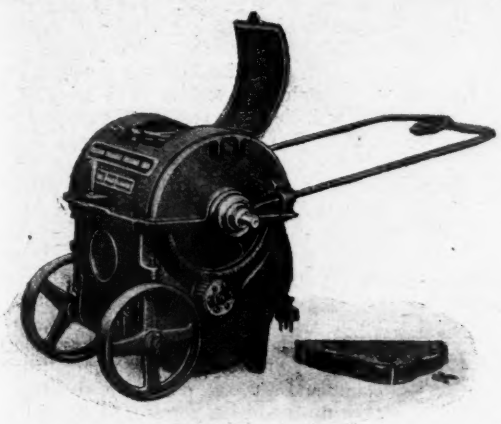


Fig. 6.

corresponding size without ribs. This device is now adopted in nearly all enclosed motors, for with such machines the provision of sufficient radiating surface is always a matter of some difficulty. As an example of the great increase of surface thereby obtained, it may be mentioned that in the case of a 15 H.P. three-phase motor there is a gain of 85 per cent. due to the ribs.

The Allgemeine Elektricitäts-Gesellschaft showed a large number of small machines, of which, perhaps, the most interesting are their portable drilling motors. Fig. 5 shows one of these with the case open. It consists of a continuous current motor of 1 H.P. in a cast-iron box, provided with a

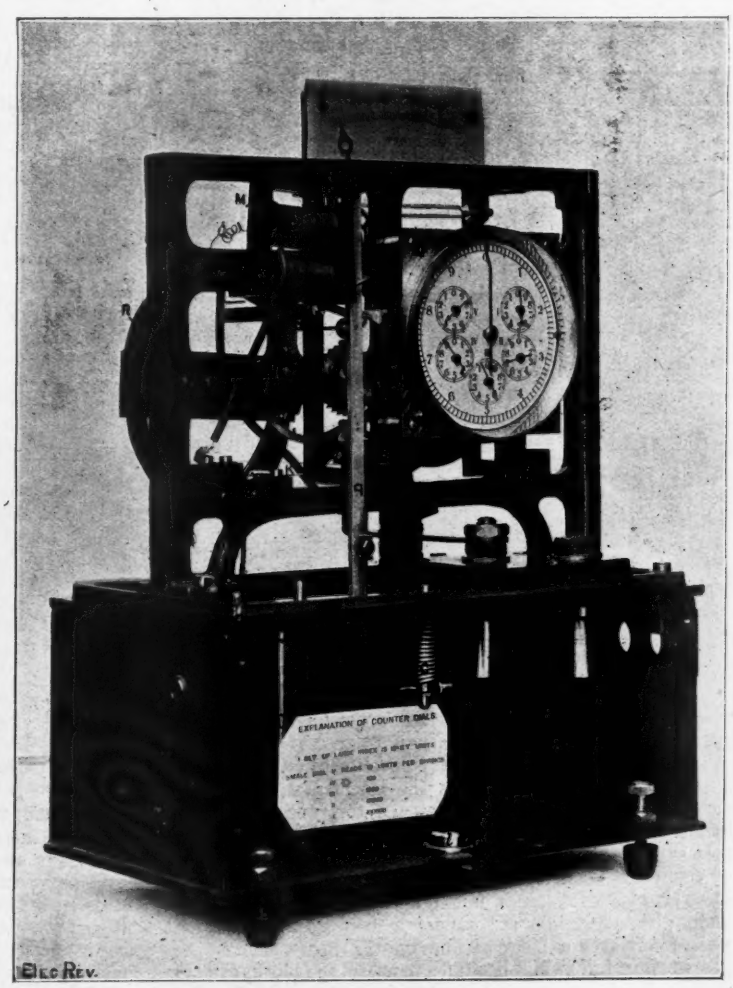
Fig. 7.

movable handle, by means of which the whole can, if required, be slung from a crane, either for transport or to enable the motor to be brought close up to its work, as, for example, in drilling girders in position. The speed is reduced by means of three spur-wheels to 210 or 450 revolutions per minute respectively. By means of a lever either of these speeds can be applied to the drill, or it can be stopped altogether without switching off the current. In the case of three-phase drilling motors, one of which is shown in fig. 6, provision is also made for driving direct off the motor spindle, if required, so that besides the two speeds above mentioned, a speed of 1,440 revolutions per minute can be obtained. The weight of the continuous current 1-H.P. motor is 5 cwt. complete, and that of the corresponding three-phase machine, slightly less. Besides the necessary starting gear, each motor carries a small tool box and several yards of twin cable wound on a drum. As will be seen from the figures, each of the wheels, of which there are but two, can be locked by means of a set-screw, so as to prevent the motor moving, owing to its vibration. Power is transmitted to the drill either by flexible shafting or by a telescopic shaft having a universal joint at each end. The former, which ranges from 5 feet 3 inches to 8 feet 6 inches in length, is constructed to transmit ·2, ·75 and 1·5 H.P. respectively, at 200 revolutions per minute, while the latter transmits 1·5 H.P. at the same speed, and can be extended from 4 feet to 6 feet 7 inches in length. The flexible shafts require supporting in the middle when running. In order to enable several drills (up to four) to be driven by one motor the machine shown in fig. 7 has been devised. The four upper spindles which communicate through flexible shafts with the various drills are driven by the lower spindle, which in its turn is connected by means of either a flexible or telescopic shaft, with the motor. This machine is designed to transmit 1·5 H.P. at 200 revolutions per minute, and weighs about 1 cwt.

(To be continued.)

THE "J. & P." ELECTRICITY SUPPLY METER

This meter, to which we briefly referred in a Note not long ago, we have now had the pleasure of examining. We give below a description of its mechanism, with photographs.

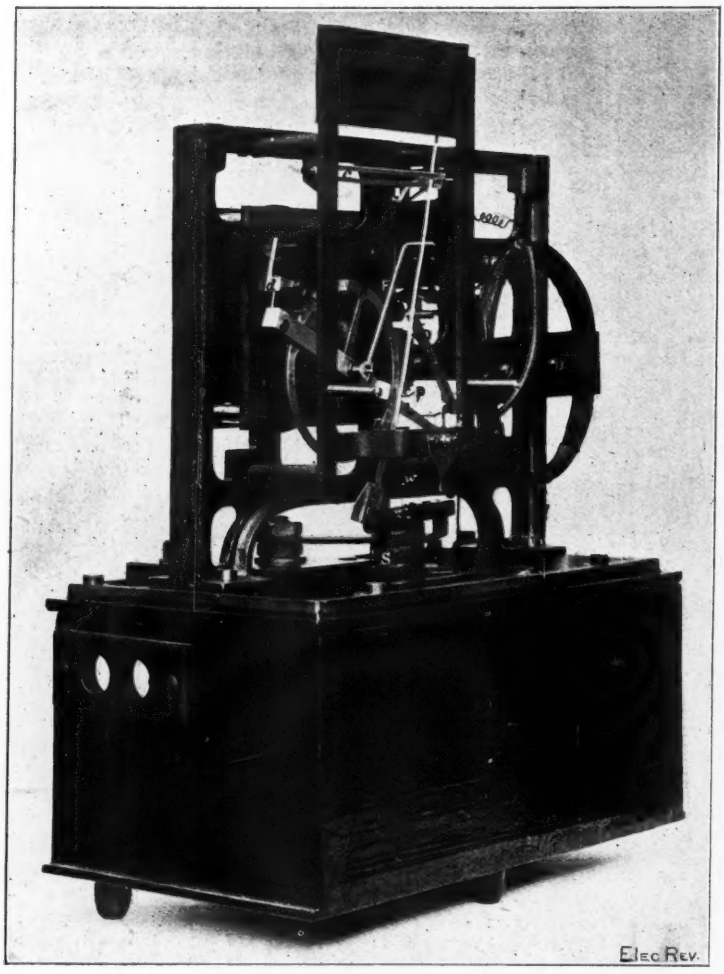


"J. and P." Meter: Front View.

It is a true integrating ammeter for direct or alternating currents, the integration being intermittent—that is, the current is measured at equal intervals of time (usually 30

seconds), and a corresponding record is made, which represents the product of the current strength and the time for each such interval. By substituting a wattmeter for the ammeter the instrument becomes an integrating wattmeter, which records the energy supplied to a circuit in Board of Trade units.

In passing, we take this opportunity of protesting against the misuse of the phrase "recording wattmeter." We assert that 99 per cent. of the engineers who use this term have never set eyes on a recording wattmeter, which is an instrument for recording power used at any instant by means of a line traced on a revolving paper cylinder, just as a recording voltmeter registers the pressure which exists at any instant in a similar manner. The proper expression for a meter which records Board of Trade units is *integrating wattmeter*, or *energy-meter*, or *watt-hour meter*; similarly, a meter



"J. and P." Meter: Back View.

which records ampere-hours is an *integrating ammeter*, or *quantity-meter*, or *ampere-hour meter*.

The meter itself presents many novel features. The controlling pendulum, which drives the mechanism, consists of an aluminium rod, P, pivoted at the top, and carrying a leaden bob; the latter swings in a separate chamber, and its beat is regulated by means of the lock nuts seen on the front of the rod. There is a small electro-magnet, M, connected in series with a resistance, R, and a key, K, across the service mains; the pendulum rod carries a loose steel pawl, which trails freely over a block of fibre on the upper side of the key when in full swing, but fails to clear the block, catches in a notch, and depresses the spring contact when the beat falls to a certain minimum extent. The key is thus momentarily closed, and the electro-magnet energised; this happens at intervals depending upon the supply pressure, on the "hit-and-miss" principle, but the effect on the isochronism of the beats is inappreciable, while the average consumption of power is said to be less than 1 watt—a very important feature. The key is always closed when the pendulum is at rest, so that the moment the main circuit is closed the pendulum starts swinging automatically, and by making the key of two springs of unequal length, a rubbing action is obtained, which ensures good contact. The motion of the pendulum is communicated to the mechanism by means of a roller carried on the pendulum rod, which tilts an aluminium lever once in each vibration. and thereby rotates the ratchet wheel, W, through one tooth. The arbor of the ratchet wheel carries a double-ended crank, D, which revolves, with the wheel, once in 30 seconds. The ammeter consists of a solenoid of heavy copper strip, S, in the main circuit, and a fine iron wire, *w*, which is 0·013 inch in diameter and 2 inches long; the latter is suspended in the upper end of the solenoid (which is about 4 inches long) from a pivoted arm, which is controlled by two hair springs, and which also carries the pointer, *p*. The pointer is normally held fast by the clamp, *c*, but during a certain part of each revolution the crank, D, raises a wire which tilts the clamp and sets the pointer, *p*, at liberty to take up a position corresponding with the current strength; during this operation the other end of the crank travels over the curved part of the aluminium lever, L, holding it at rest. The clamp is then applied, and the lever, L, by the continued motion of the crank is allowed to drop slowly, until the feeler, F, rests against the pointer; the end of the lever is provided with a light steel V-shaped pawl, which rests against the edge of the thin aluminium wheel, A, and as the crank comes into contact with the other end of the lever, the pawl engages the rim of the wheel and carries it round through a distance exactly proportional to the displacement of the ammeter pointer. The pawl is a specially noteworthy detail; it will be seen that the combination is exactly similar to that of a pawl and a ratchet wheel with an *infinite number of teeth*, so that there is no backlash or "lost motion." A similar pawl or detent, *d*, is fixed to the frame, and prevents the wheel, A, from being carried backwards by the slight friction of the pawl attached to the lever. The wheel, A, is connected by the usual gearing with a train of dials, the largest of which can be read, in the 10-KW. size, to 0·1 B.T.U. with ease. It is under consideration to replace the dials by numbered drums, as in revolution counters, &c., to further simplify the readings. A novel addition is that of a scale, visible from the outside, by means of which the consumer can tell at a glance what current he is using—if he wants to do so. The scale divisions are perfectly uniform right across the scale. To overcome the slight inaccuracy at very low currents, owing to the iron wire not being saturated, a very clever device is adopted:—One of the controlling hair-springs is firmly attached both to the frame and to the ammeter movement; the other, which is much weaker, is fixed to the latter only, while its outer end is free to rotate with the movement through a small angle before meeting a stop. In this way the controlling force is diminished for currents below the saturation value.

To convert the instrument into an energy-meter, the ammeter is replaced by an ingeniously contrived wattmeter, which, however, is the subject of patents not yet completed, and cannot be here described. The instrument is otherwise unchanged.

The loss in the main coil is very small, not exceeding 8 watts in the 100-ampere size at full load, and frictional errors are entirely absent. The framework and the base are of cast-iron. Levelling screws and a spirit level are provided in the lower chamber, which contains also main terminals of an improved form, and a catch, C, by means of which the

pendulum can be clamped for transport and freed when the meter is fixed in place.

The whole of the mechanism is enclosed in a case, which is sealed by the makers. The lower chamber, which contains all requirements for setting up and starting the meter, is provided with a door which can be sealed by the supply undertakers. High insulation is maintained throughout.

The meter, which appears to us to attain a high level of excellence and simplicity, is being manufactured under the supervision of the inventor at Messrs. Johnson & Phillips' works, Old Charlton.

The makers guarantee to keep the meter in good going order, free, for two years, provided that the works are not tampered with, and certify that the error at no part of the range exceeds 1 per cent.

THE REPORT OF THE PACIFIC CABLE COMMITTEE.

(*Continued from page* 224.)

We thus find that after reducing the paying words to four per minute by "a process which interested the Committee very much," and deducting from that limited output still another eight-letter word per minute, to ease the pressure of work, the relays of clerks, although tired of sending these three words per minute, could still continue transmitting the messages for a longer period than 10 hours out of the 24, if such work presented itself! It certainly must be admitted that it is more fatiguing to send three words per minute than, say, 18; and from that point of view it is really a cruelty to the clerk to deprive him of the extra word per minute under the plea of over-pressure, even although he has still the 3½ words of non-paying traffic to relieve him of this strain.

We have gone into this portion of the subject at considerable length, as being probably that which would be of most general interest to readers of the Review, and having examined the various opinions expressed as to the carrying capacity of various cores, and the relative proportions of paying and non-paying traffic, we will now refer briefly to the probable revenue which the Pacific cable might be expected to earn under the conditions which we have detailed. We have shown that on the part of the Eastern Extension Company, who are not unnaturally opposed to the laying of a competing cable, the estimated traffic, as allowed by them, is unduly small, being only 672,000 paying words out of the 1,948,000, which formed the total transmitted in 1895; although, even with this division of the traffic, the Eastern Extension Telegraph Company anticipate a reduction in their receipts of £118,000, should the present rates be maintained (which cannot be expected), or an annual reduction of £197,000 in their revenue, should the rate be reduced to 3s. per word. This estimate appears to be made on the assumption of a non-elastic traffic, and the large increase in the volume of the traffic which experience leads us to expect, consequent upon any considerable reduction in the rate, has, apparently, not entered into this calculation. This is strange, as not long after the Eastern Extension Company reduced the Australian rate from 9s. 4d. per word to 4s. 9d. per word, the traffic increased so rapidly that the total revenue at the reduced rate soon exceeded that of any previous year. The representatives of the Eastern Extension Company, ignoring this experience, anticipate that they would be unable to pay dividends from the Australian traffic, and that "it would be unfair to make the telegraphing public of China, Java, &c., pay higher rates than necessary for the benefit of Australia." And yet, with this sensitive regard for the purse of the public, this company does not seem to realise the unfairness of subjecting the telegraphing public of India to higher rates than they should be charged, so that the Eastern Extension Company, who do not carry messages to Europe, should derive a benefit from the joint purse agreement which they have with the Eastern and other lines which do carry these messages. The Marquis of Tweeddale assumes that, taking a rate of 3s. per word between Australia and England, this amount would be divided up as follows:—2d. to Australia, 4d. for the transit of America, and 1s. for the Atlantic cable which carried the message, leaving 1s. 6d. as the share of the Pacific cable. Mr. J. C. Lamb pointed out that the Government officers in England could do nothing to collect traffic for the Pacific route, except in as far as they would be bound by an old agreement with the Anglo-American Telegraph Company, which was made between the Duke of Montrose, as Postmaster-General, and the Atlantic Telegraph Company and the Anglo-American Telegraph Company in 1868 (31 years ago). This agreement was scheduled to the Telegraph Act, 31 and 32 Vict., c. 110, and the seventh clause is as follows:—"The Postmaster-General to hand to the companies in London all messages which can be sent by the companies' cables, and the companies to hand to the Postmaster-General in London all messages received through the cables, unless otherwise expressly required by the sender in either case." No limit of time is mentioned in this agreement, but it appears that a memorandum was passed between the Postmaster-General and the companies relative to the above Act of Parliament, by which the agreement is limited to 30 years, with clauses providing for a revision of its terms at various specified periods. As the 30 years mentioned in the memorandum have expired, it would be of interest to know what revision has been made, as the Act must have the effect of placing the majority of the Atlantic traffic originating in the United Kingdom at the disposition of the Anglo-American Telegraph Company, who are thus, to a great extent, supported by the English Government against competition.

Mr. Lamb criticises the possible action of the Commercial Cable Company in regard to the collection of traffic for the Pacific route, by saying that it would "give rise to a certain amount of adverse comment that a competitive foreign company was practically acting as agent for a Government line," which presumably means that it would be indelicate on the part of the Commercial Cable Company to attract traffic over their cable, if to reach its destination such traffic had ultimately to pass over the Pacific cable.

Mr. Lamb also said that the Post Office could do nothing towards procuring traffic for the Pacific cable, but does not say by which *viâ*, "Pacific" or "Eastern," the unrouted messages handed in at English telegraph offices would be sent. In virtue, however, of the Act above cited it appears that the English Post Office would be compelled to hand all unrouted traffic for Australia over to the Anglo-American Company, which is, of course, equivalent to routing this traffic *viâ* Pacific. This witness agrees pretty nearly with the Eastern Extension Company's representatives in estimating that one-third of the traffic from Australia would be all that would fall to the share of the Pacific route, and that with a 3s. rate the Pacific cable would retain about 1s. 6d. At this rate Mr. Lamb estimates that for the first year the revenue of the Pacific cable would be £46,500, and that, with a traffic increasing at the rate of 7 per cent. annually, in the tenth year the revenue would be £85,480. In general reference to the laying of the Pacific cable, after referring to the probabilities of cables being laid across the Pacific by foreign Governments, the chairman put the following question to this witness:—

2,395. You would rather see a cable across the Pacific going to Japan and China and to Australia respectively entirely in foreign hands than you would see a British cable in British hands if it was subsidised by the British Government?—Well, I would rather put my answer in this way: that I doubt whether the British Government would be justified in subsidising the cable across the Pacific in order to prevent a foreigner from laying a cable, but of course I would prefer that the whole enterprise, if it is carried out, should be in the hands of the British.

Mr. R. K. Gray pointed out that New South Wales, Victoria, Queensland, and New Zealand being interested in the Pacific cable and controlling the collecting stations, would probably give all their messages to this cable, while in England all the trans-Atlantic cable companies would be anxious to have an increase of traffic, and would therefore become collectors for the Pacific route in Great Britain. The Eastern and the Indo-European Telegraph Companies being the only collectors in Britain for the existing cables have 16 collecting offices in the United Kingdom, while the trans-Atlantic companies have amongst them 58 collecting centres.

Mr. Reeves in his evidence laid stress on the steady growth of telegraph business in New Zealand during years in which

this colony was "not specially prosperous." Mr. N. Cork expressed the opinion that the volume of telegraph business with Australia is constantly increasing, his own experience being that between 1891 and 1896 the increase in the number of messages was 63 per cent. The witness also gave an interesting account, showing how the use of the telegraph is gradually but steadily growing in banking business as the rates are decreased. The evidence given by Messrs. T. E. Doxat and C. U. Kingston fully corroborated the opinion expressed by Mr. Cork.

Sir Sandford Fleming, on a basis of a 3s. rate between England and Australia, assumes that the Pacific cable will take 2s. of this amount, and that 50 per cent. of Australian traffic, including the traffic which will arise in Canada, will accrue to the Pacific line. He also pointed out that during the last 20 years the average increase in traffic had been 36·4 per cent., and that in his estimates he had taken less than half of this increase on which to base his calculations.

IPSWICH AS AN ENGINEERING CENTRE.

By E. K. SCOTT.

It is rather surprising that of the London firms who from various reasons have found it advisable to remove their works into the country, none should have hit upon Ipswich. This town seems to be eminently suited for the establishment of engineering works, especially those laying themselves out for colonial and foreign trade. Situated as it is on the Orwell, which is practically an arm of the sea, fairly large steamers can come right up to the Ipswich quays, and in any case it is an easy matter to barge down to Harwich and load direct on to ocean-going boats.

The steady expansion of such well-known firms as Messrs. Ransome, Sims & Jeffries and Messrs. E. R. & F. Turner shows that Ipswich is a good centre for engineering work, and also indicates that suitable workmen and mechanics are to be found in the neighbourhood. With the value of land increasing so rapidly, London will become more and more the city of the middleman, the merchant, and the banker. It is certainly no place for the working mechanic, who likes a bit of ground where he may grow his own vegetables and fruit. As Mr. Orcutt has so eloquently pointed out in the *Engineering Magazine*, the prosperity of an engineering works is intimately bound up with the well being of the workmen, and this is one of the principal reasons why up-to-date engineering establishments in provincial towns go ahead so much more rapidly than old established works and firms which continue to carry on in London.

As with Newcastle-on-Tyne, Ipswich is only served by one railway, but the Great Eastern Company treats the town exceedingly well. The London service consists of over 24 trains each way daily, the time occupied by a single journey being only 1½ hours. Day excursions are run to Manchester for 6s. return as a regular thing, and the boat service from Harwich to Antwerp and the Hook of Holland is one of the most remarkable instances of railway company's enterprise which this country can show.

Messrs. Reavell & Co. have recently set up works in Ipswich for the manufacture of high-speed engines, and Messrs. Maudslay, Sons & Field are moving down there from Westminster Bridge Road. It is also rumoured that a large works for the manufacture of torpedoes is about to be started.

CORRESPONDENCE.

Bankruptcy Proceedings.

In your report of my public examination, you have omitted a very important fact which is sure to do me a great deal of harm in the electrical world. Out of the liabilities which were returned at £4,514, the London and District Bank has a claim of £3,464, which I stated in my examination I knew nothing about. They kept the books, received all takings, and found all monies to carry on the business. How then could I owe them this money when I received from them only my salary?

I took sole control of the business November 24th, 1898, at which time the liabilities to creditors was £1,300. On June 8th, when the petition was presented, the liabilities had been proved to be only about £800. Add to this £150 which I agreed to pay the bank for the £120 they paid the official receiver for the estate of Inrig & Chester, gives us a total of £950. This sum includes £250 claimed for goods on order but not delivered, so that my total indebtedness is only about £700.

At the time the bank took this drastic action I had on my books orders for about £2,000 worth of work, on which about £600 had been spent. The value of my machinery, stock, and plant at invoice prices was £1,864.

I took the business over from the bank with a debt of £1,300, and in seven months I had paid off £600 of this, and could have cleared it all in another four months.

The bank is clearly liable for all these trade debts as there was double the amount when I took control, but had they left me alone I could and would have paid them all.

Alec Gavan Inrig.

CORRESPONDENCE.—Pressure upon our space compels us to hold over until next week a letter by Mr. Arthur Shippey on "Converting old electric lamps into new," also another communication from a correspondent on the "Renewable lamp."—EDS. ELEC. REV.

THE TELEPHONE BILL.

THE Telegraph Act, 1899, is not a very voluminous document, so that we are enabled to print it in full for our readers' information. By this Act, the Government afford facilities for competition in a service in which there should be no competition, and defer indefinitely, if they do not altogether prevent, the acquisition of a complete service by the State. We do not think this Act can be regarded otherwise than as a temporary measure, but we hope, nevertheless, that the popularisation of the telephone, which is desirable—indeed, necessary—may be one of its results.

An Act to make further Provision for the Improvement of Telephonic Communication, and otherwise with respect to Telegraphs.

[August 9th, 1899.]

Be it enacted by the Queen's most Excellent Majesty, by and with the advice and consent of the Lords Spiritual and Temporal, and Commons, in this present Parliament assembled, and by the authority of the same, as follows:—

1. The Treasury may, without prejudice to the exercise of any powers previously given for the like purpose, issue out of the Consolidated Fund or the growing produce thereof such sums not exceeding in the whole the sum of two million pounds, as may be required by the Postmaster-General for the purpose of the Telegraph Acts, 1863 to 1897, according to estimates approved by the Treasury, and sub-sections two and three of section one of the Telegraph Act, 1892 (which relate to the mode in which money may be raised) shall apply with respect to the sum so authorised to be issued.

2.—(1.) Where the council of a borough or an urban district are licensed by the Postmaster-General to provide a system of public telephonic communication, they may defray the expenses of exercising the powers conferred by the license in the case of a borough out of the borough fund or borough rate, and in the case of an urban district not a borough out of the rate out of which the general expenses of the council in the execution of the Public Health Acts are defrayed, and may borrow money for the purpose in accordance with the Public Health Acts, but in the case of a borough any money so borrowed shall be borrowed on the security of the borough fund or borough rate; and the council may, subject to the provisions of the Telegraph Acts, 1863 to 1897, and of the license, exercise their powers under the license throughout the area for which it is granted, although part of that area may be outside the borough or urban district.

(2.) In the application of this Act to Scotland, a Royal or Parliamentary burgh shall be substituted for a borough, and a police burgh for an urban district, and the town council or commissioners thereof, as the case may be, for the council of a borough or urban district, and for the borough fund or borough rate, or rate out of which the general expenses of an urban district council in the execution of the Public Health Acts are defrayed, there shall be substituted the police or the burgh general assessment, or, where there is no assessment so named, an assessment under any head of the burgh assessments or city

rate under any local Act payable by occupiers only; and the town council or commissioners, as the case may be, may with the consent of the Secretary for Scotland, borrow for the purposes of this Act on the security of that assessment or rate, but subject to the conditions for the repayment of loans prescribed by the Public Health (Scotland) Act, 1897.

(3.) In Ireland expenses incurred for the purpose of this section may be defrayed as expenses incurred in the execution of the Public Health (Ireland) Acts, 1878 to 1896, for sanitary purposes, and money may be borrowed accordingly.

3.—(1.) Where an existing company have before the passing of this Act, under a license from the Postmaster-General, provided a system of public telephonic communication in any exchange area, and it is proposed to grant a new license to a local authority or to another company to provide public telephonic communication in the same exchange area, or any part thereof, then, if the existing company consent to it being made a condition of their license—

(*a*) that they will not give favour or preference to any person whomsoever within the area specified in the new license, and will not, within that area, as a condition of giving a service, require from any person the grant of any facility except for the purpose of supplying telephonic communication to that person; and

(*b*) that their charges shall not, within the area specified in the new license, exceed the maximum rates or fall below the minimum rates authorised in that behalf by the Postmaster-General within that area,

it shall be a condition of the grant of the new license, that where it is proved to the satisfaction of the Postmaster-General that the existing company have incurred or contracted to incur, in the area specified in the new license, material expenditure in laying down underground wires, and have by agreement with any local authority within that area acquired powers for that purpose, those powers shall continue for the period specified in the new license for the duration thereof, but, subject as aforesaid, on the terms and conditions specified in the agreement (including any provisions thereof for determination on breach of covenant), except so far as they may be varied by any subsequent agreement with the local authority.

(2.) Where an existing company is at the passing of this Act under a license from the Postmaster-General supplying public telephonic communication in any exchange area, a license to provide a system of public telephonic communication within the same area, or any part thereof, shall not be granted by the Postmaster-General to any person or body other than the council of a borough or urban district, unless it is shown to the satisfaction of the Postmaster-General that the application for the license is approved by the council of each borough or urban district within which it is proposed by the application to establish a telephonic exchange.

(3.) An existing company shall not, without the consent of the Postmaster-General given after the passing of this Act in each case, open an exchange in any exchange area in which they had not, before the passing of this Act, established an effective exchange.

(4.) Where a local authority or a new company, under a license from the Postmaster-General, provides a system of public telephonic communication in the whole or any part of an exchange area in competition with an existing company licensed by the Postmaster-General before the passing of this Act, then, if the existing company consent to it being made a condition of their license:—

(*a*) That they will not give favour or preference to any person whomsoever within the whole of the exchange area in question, and will not, within that exchange area as a condition of giving a service, require from any person the grant of any facility except for the purpose of supplying telephonic communication to that person; and

(*b*) that their charges shall not within the whole of the exchange area in question exceed the maximum rates and (where the company are empowered by agreement with the local authority to lay underground wires) shall not fall below the minimum rates authorised in that behalf by the Postmaster-General within the area specified in the new license,

the license of the existing company shall within the whole of the exchange area in question be extended and continue for the period specified in the new license of the local authority or new company for the duration of such new license, but, except as varied by this Act, the provisions of the license of the existing company (including any provisions thereof for determination on breach of covenant) shall remain in force.

(5.) If the license of an existing company is, under the provisions of this section, extended in respect of any exchange area for a period of not less than eight years beyond the term existing at the passing of this Act, the company shall, at the request of any other licensee of the Postmaster-General providing public telephonic communication in the whole or any part of that exchange area, and under such circumstances and on such terms and conditions as may within six months from the passing of this Act, be prescribed by an order of the Postmaster-General, made with the approval of the Treasury, afford all proper facilities for the transmission of telephonic messages between persons using the system of the company (either in the whole or in part of the exchange area, as the Postmaster-General may prescribe) and persons using the system of such other licensee, provided that the licensee so requiring inter-communication shall in any such case afford similar facilities.

(6.) For the purposes of this section, the expression "exchange area" means an exchange area as defined by any agreement made by an existing company with the Postmaster-General before the passing of this Act.

4. This Act may be cited as the Telegraph Act, 1899, and may be cited with the Telegraph Acts, 1863 to 1897.

BUSINESS NOTICES, &c.

Electrical Wares Exported.

Week ending Aug 16th, 1898.		Week ending Aug. 15th, 1899.	
Adelaide	Value £25	Adelaide. Teleg. mat.	Value £1,675
Alexandria	27	Amsterdam	30
Antwerp	45	Bombay	52
Bombay	28	Brisbane	27
Bordeaux	25	Buenos Ayres	845
Bolougne	225	" Teleg. mat.	279
Buenos Ayres	9	Calcutta	214
Calcutta	691	" Elec. cable	288
Cape Town	144	" Elec. machinery ..	2,770
Colombo	287	" Teleg. wire	71
Demerara	9	Cape Town	434
" Teleg. mat. ..	640	Christiania. Teleg. mat. ..	988
Dunkirk	900	Colombo	40
Durban	155	Durban	164
Halifax	350	East London	273
Hamburg	280	Fremantle. Teleg. mat. ..	242
Hobart	468	Genoa	460
Melbourne	139	Hobart	330
Paris	18	Korsor. Teleg. cable	3,189
Penang	81	Madras	27
St. Petersburg	30	Melbourne	95
Shanghai	68	Ostend	46
Sydney	157	Port Elizabeth	1,646
Wellington	25	" Teleg. wire ..	105
		Port Said	16
		Rosario	87
		Rotterdam. Teleg. mat. ..	85
		Singapore	104
		St. Petersburg. Elec. motors ..	67
		Stockholm. Teleg. mat. ..	1,205
		Sydney	24
		Trinidad	15
		Wellington	204
		" Teleg. mat.	80
		Yokohama	53
		" Teleg. mat. ..	671
		" Teleg. wire ..	671
Total ..	£4,286	Total ..	£17,522

Foreign Goods Transhipped.

Durban. Telephones ..	Value £29
Paris. Elec. machinery ..	80
Trinidad. Teleph. apparatus ..	39
Total ..	£148

American Electrical Apparatus for China.—Our New York namesake says that the Westinghouse Electric and Manufacturing Company, of Pittsburg, with its kindred interests, has been awarded the entire contract for the equipment of the numerous electrical plants which will be installed on the Chinese Eastern Railroad. The contract at present calls for the immediate delivery of three temporary electric lighting plants, each comprising 15 H.P., 20 H.P., and 60 H.P. Westinghouse dynamos. The shipments about to be made are estimated to be worth some $40,000, but, as the apparatus now ordered is only for temporary work, it is assumed that $200,000 will ultimately be involved in the contract.

Arc Lamp Masts.—Messrs. John Spencer, Limited, of Wednesbury, have just completed two electric light masts for the front of the pier and the new square, for the Corporation of Bournemouth. The masts are of wrought steel to designs by Mr. F. W. Lacy, and are 62 feet high by 21 inches diameter, and ½ inch thick.

Bankruptcy Proceedings.—A receiving order has been made in the case of L. Lawrence (Lawrence & Butcher, 5, Stafford Street, Old Bond Street, W.), electrical engineer, on a creditor's petition.

Notice is filed in the *London Gazette* of release of trustee (Mr. H. Brougham) in the case of E. A. Ingold, electrical merchant, Wandsworth Bridge Road.

At Bradford, last week, Arthur B. Blackburn and J. Walker (Blackburn, Walker & Co., electrical and mechanical engineers, Cleckheaton) came up for public examination. The debtors started in Batley Carr in 1893 as electrical engineers, with £10 of their own capital and £30 borrowed. In every year since 1895 they lost money over contracts, and £50 had been lost experimenting. They had not drawn more than an average of 10s. per week. The examination was closed.

At the Liverpool Bankruptcy Court last week, the case of Messrs. Wild, Rothwell & Co., electrical and general engineers, Southport, was up for consideration. An adjournment to October 5th was granted, so that the accounts which had been ordered might be completed.

The first meeting and public examination has been arranged for August 4th and September 19th respectively, in the failure of L. J. Lawrence, electrical engineer, Stafford Street, Old Bond Street, W.

Liquidations, Dissolutions, &c.—The Woking Sanitary Electric Laundry Company meeting at Palace Chambers, Westminster, has resolved to reconstruct. Mr. E. Mann was appointed liquidator to wind up the company. The new company is to be known as the Woking Laundry Company.

The Hiram S. Maxim Electric Lighting and Engineering (Pioneer) Syndicate is winding up voluntarily. Mr. H. C. Emery, 15, George Street, Mansion House, E.C., is liquidator.

Messrs. J., J. W., and A. E. Palmer (John Palmer & Sons, ironmongers and electricians, of Clifton, Redland and Bristol) have dissolved partnership.

A meeting of New & Mayne, Limited, is to be held at 33, St. Swithin's Lane, E.C., on September 20th, to hear an account of the winding up from the liquidator, Mr. D. F. Basden.

Bills which have received the Royal Assent.—The Royal assent has been given to the following Acts:—

Electric Lighting (clauses) Act, 1899.
Telegraph Act, 1899.
Tramways Orders Confirmation (No. 2) Act, 1899.
" " " (No. 3) "
Electric Lighting Order Confirmation (No. 20) Act, 1899.
Moss Side Tramways Act, 1899.
Stretford Tramways Act, 1899.
Withington Tramways Act, 1899.
Weston, Clevedon, and Portishead Light Railways Act, 1899.
South Staffordshire Tramways Act, 1899.
Wolverhampton Tramways Act, 1899.
City and Brixton Railway Act, 1899.
Gateshead and District Tramways Act, 1899.
Manchester Corporation Tramways Act, 1899.
Southport District Tramroad Act, 1899.
North-West London Railway Act, 1899.
Brompton and Piccadilly Circus Railway (Extensions) Act, 1899.
Charing Cross, Euston, and Hampstead Railway Act, 1899.
Newcastle-upon-Tyne Tramways and Improvement Act, 1899.
Bradford Tramways and Improvement Act, 1899.

Catalogues and Lists.—From the "Cotsworth" Arc Lamp and Electric Lighting Syndicate we have received a trade price list of the Cotsworth arc lamps and accessories. Descriptive notes and illustrations are given of the lamps of standard, plain, factory, and inverted types.

Mr. T. M. F. Tamblyn-Watts, of Goldielands, Settle, Yorks, has brought out an electrical catalogue which is intended to serve as a guide in the selection of electrical apparatus for laboratory or for students' use. Various materials have been included in the list, such as wires, bells, telephones, switches, &c, in addition to experimental apparatus, and prices and a few illustrations are given.

Mr. S Schreiber, of Victoria Avenue, Bishopsgate Street Without, sends us a descriptive circular and price list relating to rawhide pinions for noiseless gearing which have been used with good results in the United States and elsewhere for some years past, and also by leading English engineering firms. The rawhide material employed has been made for 25 years past by the Chicago Rawhide Manufacturing Company, Chicago, by a special process. It is claimed to possess great hardness, strength, toughness, general strain resisting qualities, to be impervious to atmospheric changes and to be eminently suitable for electric motor work, motor cars, printing machinery, &c.

We have received from the Cutter Company, Philadelphia, a list of the Q. C. rheostats, in which types B., C., and D. motor starting rheostats, are illustrated, general particulars, code words and prices being also given. The Q C. field rheostats for different voltages (75 to 500) volts are also included.

Messrs. Polland & Co., of Newcastle-on-Tyne, send us an illustrated circular of the domestic telephone system based on the "P. H. C." micro-telephone, which enables one to use the wiring of any existing electric bell system for telephoning by changing the old pushes for new ones with the metal tubes for pin connectors.

The Edison & Swan Co. has issued a leaflet (No. 130) describing the "Monarch" adjustable ball fitting, which permits the light to be swung from one side of a room to the other without having the flexible cord in any way encumbered, and will sustain any size of enamelled iron or opal glass shade, from 6 inches to 12 inches diameter. The construction is very simple, there being no springs to break, or other mechanism to get out of order, thus rendering it suitable for almost every purpose where a movable light is required. The fitting consists of two balls, the upper ball having a recess on one side of centre in which is a pulley of hard vulcanized fibre. On the opposite side of the centre a hole passes through the ball in a slanting direction from a point in the centre of the upper surface to a point one side of the centre of the lower surface. The lower ball is weighted, and is fitted with a grooved pulley of hard fibre. The flexible cord passes down through the hole in the upper ball, round the pulley in the lower ball, up round the pulley in upper ball and down to the lampholder. The cord not does pass through the lower ball in going to the lampholder, but is left to swing free, thus allowing the light to be carried to any point of angle without being encumbered by the counterweight. The flexible cord between the upper ball and ceiling rose serves as a swivel, allowing one to walk around the room with the light. The fitting is also supplied with a special attachment consisting of a simple revolving shuttle, to which is attached an insulating hook to catch the flexible cord, the shuttle being wound with about 10 feet of line to the free end of which is fastened a five-pointed hook, which permits of its being fastened to a window casing, picture moulding, pigeon-hole of a desk, &c. It is considered well adapted for use in offices, reading rooms, libraries, machine shops, &c.

Charge Dismissed.—The Hon. Charles Rolls and Mr. Ernest Hutton, J.P. were summoned at West London by the police for unlawfully driving motor cars at a speed greater than is reasonable or proper, having regard to the traffic in the highway. Constable Beck said the defendants on the 26th ult. each drove a motor car along Palace Gate, Kensington, and witness estimated the speed they were travelling at as between 14 and 16 miles an hour. Prof. C. V. Boys, F.R.S., said the car ridden by Mr. Rolls was an electrical one, and could not be driven at a high speed. The magistrate was satisfied on the evidence that the constable had been mistaken, and dismissed the summons.

Conditions of Engineer Employment in Germany.—The report for this month of the Amalgamated Society of Engineers, which is abstracted in the *Birmingham Daily Post* for Wednesday, contains some interesting statements by Mr. G. N. Barnes, the secretary, on the conditions of labour in a number of the German engineering works, as shown during a recent "mission" authorised by the society. Workshops were visited in Düsseldorf, Augsburg, Chemnitz, and Berlin. It is stated that "the fencing of machinery, the general protection of workmen, and provision for their comfort are much more complete than in this country, and the shops are more spacious and cleanly. This may be, to some extent, due to stringent Government inspection, brought about contemporaneously with, if not as the result of, accident and other insurance laws; but I am inclined to think that much of it is due to voluntary initiative on the part of employers. Another common feature is the modern appearance of most workshops and the use of first-class appliances. Everywhere new factories are building; machinery is being put down, and a great deal of that at work is dated this year or last. A no less marked feature common to German workshop life is the leisurely manner in which the men go about their work. Although piecework is common, I saw no bustle. With one exception, in all the shops visited men smoked during working hours, and in most of them there were canteens or other provision for getting refreshments while at work." The report states that: "In regard to hours of labour and wages they, of course, compare unfavourably with those current in this country, although there is certainly not the marked difference which is here generally supposed. And when due allowance is made for the stopping time for refreshments, it is doubtful if the actual working time much exceeds that in the area covered in this country by the Employers' Federation. At Düsseldorf the outside or inclusive hours are 60 per week, with one main break in the day—namely, from 12 to 1 30. In Augsburg the hours are the same as at Düsseldorf. But there are two recognised breaks for refreshments in the forenoon and afternoon of a quarter-of-an-hour each, which takes three hours per week from the inclusive time. At Chemnitz the hours are about the same, but vary a little from shop to shop. At Berlin the working day is shorter than elsewhere, but, curiously enough, it varies considerably, in some cases being different in length in different departments of the same firm. The maximum inclusive time is, however, 59 hours per week and the minimum 54. The shortest working day obtains in the largest, best-equipped, most scientifically organised, and best-paying concerns, those of the Allgemeine Electricitäts Gesellschaft, which employ some 14,000 people, and Messrs. Siemens & Halske's, employing nearly as many." Detailed accounts are given as to wages. At Düsseldorf the wages of some 1,200 workpeople averaged over 4s. per day. This included boys and labourers. Most of the fitters and turners were on piecework. There was no sub-contracting, each man being paid through the office, and skilled men earning about 6s. per day as a rule; young men less. The smiths, however, earn more, the earnings of the leading heavy workman averaging 12s. to 13s. per day. The apprentices, who all work together, get 9d. per day for the first year and serve three years. Baths for the workpeople were found at some works, besides refreshment houses and dining-rooms, and on the whole the appointments for the care of those employed would seem to be excellent. Most of the machine tools used were found to be of German make, but there were a few from America and from this country. Altogether the report affords ample evidence of the progressive character of engineering work in Germany.

Crystal Palace School of Practical Engineering.—On Friday last, August 11th, the list of certificates awarded by the examiners in the lecture theatre of the school was presented, Mr. Francis Fox, M.I.C.E., joint engineer of the Great Central Railway, presiding. The report of the examiners showed among other things that in the electrical section the dynamo work of the second term was declared to be particularly satisfactory. Mr. Fox, in his address, referred to a visit he had recently made to America, which showed him that this country is behindhand in engineering, electric light and traction matters. He remarked that men would have to become more highly technical and specialised, or Englishmen would be superseded by Americans in foreign posts and work. Mr. Fox seems to think that there is a great necessity for us to wake up or we shall lose our supremacy, and England may no longer be the workshop of the world.

Electric Launches at Colombo.—Trial trips were successfully made recently with the two new electric launches, the *Water Nymph* and *Venus*. We understand that the electrical apparatus has been made by the Thames Valley Launch Co., Limited, Weybridge, England. The motor is placed at the bottom of the boat—at the stern, while under the seats, which are placed all round the boat, the batteries are put. The electricity is generated by means of a dynamo near the Pettah station, but enough can be stored on the boat to work it for 16 hours, so that a fresh supply will be taken in each day, before starting, the working hours being from six in the morning till nine at night. The power is four-horse, and the boat draws two feet of water. The seats are placed in the larger part of the boat and there is room for 50, for which number the boat is licensed.

For Sale.—The Borough Engineer of St. Helens, Lancashire, is offering for sale a vertical boiler and two Bumstead and Chandler engines, direct coupled to two Castle dynamos. See "Official Notices" this week.

Hull Trucks.—Mr. Maskell E. Curwen, of Victoria Street, S.W., selling agent on this side for the J. G. Brill Company, of Philadelphia, writes as follows:—

We beg to call your attention, which we neglected to do at an earlier date, to your issue of July 21st, page 110. You refer to the truck under the Hull cars as being supplied by the Peckham Company. We desire to call your attention to the fact that all of the trucks so far supplied to Hull are made by the Brill Company, and on page 108 of your above number you show a picture of one of the Hull cars mounted on its truck, said truck showing very plainly that it is a Brill truck. We shall be glad if you will take steps to have this properly corrected at your first possible opportunity.

Finsbury Technical College.—The following is a list of the students who have regularly attended a complete course of instruction for day students (extending over a period of two years for mechanical and electrical engineering students and three years for chemical students) at the Finsbury Technical College, and have now satisfactorily passed the several class examinations:—

Name.	Course.
Bartlett, Arnold W., London C.C. Inter. Scholar	Mechanical Engineering.
Brown, Dugald A., London C.C. Inter. Scholar	Electrical Engineering.
Cazeaux, Sebastian	Mechanical Engineering.
Conradi, Emile S.	Mechanical Engineering.
Cooke, Stanley W.	Mechanical Engineering.
Crush, Hugo P.	Mechanical Engineering.
Endacott, Arthur P., Devon C.C. Scholar	Mechanical Engineering.
Eynon, Lewis	Technical Chemistry.
Fiddian, Kenneth W.	Electrical Engineering.
Fisher, Percy A., London C.C. Inter. Scholar	Electrical Engineering.
Holliday, James W., London C.C. Inter. Scholar	Electrical Engineering.
Howgrave-Graham, Robert P.	Electrical Engineering.
Jeffery, Walter J., Middlesex C.C. Scholar	Mechanical Engineering.
Jollyman, Walter H.	Technical Chemistry.
Jones, Thomas M.	Mechanical Engineering.
Levy, Arthur G.	Technical Chemistry.
Lillywhite, George H.	Mechanical Engineering.
Linford, Walter J., Somerset C.C. Scholar	Electrical Engineering.
Lonnon, William U.	Mechanical Engineering.
Lyddon, Hugh E., London C.C. Inter. Scholar	Mechanical Engineering.
Monk, Reuben G., London C.C. Inter. Scholar	Mechanical Engineering.
Morshead, Leslie R.	Electrical Engineering.
Murphy, Leonard, London C.C. Inter. Scholar	Mechanical Engineering.
Paxton, George S.	Technical Chemistry.
Rolph, William M.	Electrical Engineering.
Seeley Charles G.	Electrical Engineering.
Slaney, George H. T.	Mechanical Engineering.
Smallpage, Rupert S.	Mechanical Engineering.
Stacey, Francis	Electrical Engineering.
Theobalds, Vincent W.	Technical Chemistry.
Trimen, Stephen H.	Technical Chemistry.
Trussler, William T.	Electrical Engineering.
Vigor, Theophilus H., London C.C. Inter. Scholar	Mechanical Engineering.
Walsh, Thomas C.	Technical Chemistry.
Wechsler, Elkan	Technical Chemistry.
Woodward, Percy J.	Electrical Engineering.
Yates, Charles F.	Technical Chemistry.
Young, Ernest V.	Electrical Engineering.

Madras Electric Tramways Company, Limited.—On 19th inst. in the Companies Winding-up Court, Mr. Justice Wright, sitting as an additional judge of the Chancery Division of the High Court of Justice, had before him a petition for the compulsory winding-up of the above company, presented by the Electric Construction Company, Limited. We briefly mentioned the case last week.

Mr. Eve, Q.C., said he appeared for creditors for £32,000 odd, and for other creditors for a like amount.

Mr. Herbert Reed, Q.C., who appeared for the Madras Company, asked his Lordship not to make the order applied for, as no useful purpose would be served by winding up the company, on all the property of which the applicants held a first mortgage; they had debentures covering everything, and there was nothing else whatever. They had been in that position for a long time. His (counsel's) affidavit showed that the company was formed to construct tramways in Madras, the period of construction occupying a long time, and there had been considerable delay, but it was believed that if they were got into working order and a reasonable time allowed them, there would be enough to pay all the debenture holders. It was also proposed to have another form of electrical construction, and recently the petitioners were offered £65,000 to pay them off, their (the petitioning creditors') debt being £72,000 on their own statement, allowing for all the interest which was due to them; and they being the mortgagees in possession. His Lordship would see that the margin was exceedingly small, and if petitioners had been willing to take the £65,000 they would have been paid off. The affidavit also stated that a strong committee was now being formed in Madras. The position of affairs was very serious, as the shareholders were in many instances natives of Madras and people in poor circumstances, who had invested all they had in the company, and the whole of whose interest would be destroyed through winding-up. Trustees of the debenture holders had been appointed in Madras, and they hoped to be in a position to work the tramways. All the troubles of the company had been caused by the petitioning creditors. Great damage was caused by delay, and the company was obliged to submit to have work done by those creditors, which gave the latter the right under which they now petitioned. The directors strongly believed in the future of the company, and as a proof of that he (Mr. Reed) might say that for five years they had given up their fees, and the chairman had also given up his fees, which alone amounted to £650 a year.

Mr. Eve, in reply, said that in March, 1898, an agreement was come to between the company and the British Electrical Company with a view to seeing whether the latter would take it over and get rid of the creditors. They gave them from March, 1898, to June this year to make some arrangement of that kind, and they had held their hands for 15 months. In order to raise a sum of £8,000 a second series of debentures was issued, and out of that £3,000 was paid to the British Electrical Company. What they complained of was that an office was being kept open in Madras, for which the petitioners had to find the money. There was not a penny coming in for the shareholders to enable that office to be kept open, and it was only piling on liabilities, which would go on increasing, if they allowed the matter to stand over. That would be to the prejudice of the petitioners.

After some further argument, his Lordship ordered the case to stand over until the first petition day in November. If by that time nothing had been done the order for winding-up would be made.

Phillips' Monthly Register.—Mr. C. D. Phillips (*Phillips' Machinery Register*), of Newport, Mon., announces that he has just opened an electrical department. He has decided to publish a supplement of new and second-hand electrical plant for purchase and sale along with his monthly register.

Plymouth Electric Tramways.—In our article on Plymouth electric light and tram undertaking last week, we omitted to say that the Peckham trucks, and all overhead line material were supplied and successfully erected by Messrs. R. W. Blackwell & Co., of London, who were sub-contractors to Messrs. The Westinghouse Electric Company of London.

Phosphor Bronze Company.—A petition presented to the High Court of Justice for confirming a resolution reducing the capital of the Phosphor Bronze Company from £90,000 to £45,000, will be heard by Mr. Justice Kekewich, on October 28th.

Suicide.—On Saturday last, A. R. Marshall, formerly employed by the National Free Wiring Company, of Egremont, committed suicide at Seacombe, by shooting himself. A warrant had been issued on the previous day for his arrest on a charge of embezzling money belonging to the company.

The Castner-Kellner Litigation.—A financial paper understands that the Castner-Kellner Co.'s recent application to the House of Lords desiring that the Commercial Development Corporation, Limited, should, in the event of the former succeeding in their appeal to the House of Lords, give an undertaking to repay any costs they have been ordered by the Court of Appeal now to pay, failed, as a similar application to the Court of Appeal had previously failed.

Theft.—At Southwark, on Monday, George Smith, 37, was sentenced to six months' hard labour for stealing a coil of electric wire, value £6, from Mr. V. G. Middleton, electrician, who had been carrying out some work at Messrs. Clowes, printers, Duke Street. As considerable quantities of wire had been missed, a galvanometer was made to play the part of a thief detector. Two wires connected the coil with the warehouse so that immediately the coil was touched the needle of the galvanometer would move and thus indicate what was taking place. Prisoner was caught handing the wire over to a woman.

The Glasgow 1901 Exhibition.—We read in the *Engineer* that the Machinery and Electric Lighting Committee of the Glasgow International Exhibition, 1901, have agreed to accept as exhibits for producing steam for electric lighting and motive power, the following:—Lancashire boilers from Messrs. Penman & Co., Glasgow; water-tube boilers from Messrs. Babcock & Wilcox, Limited, Glasgow; Messrs. Stirling & Co., Limited, Edinburgh; Messrs. Weir, Limited, Cathcart, Glasgow; Mr. W. E. Berry, Manchester; and Messrs. Penman & Co., Glasgow. It is estimated that the total power required will be about 5,000 H.P.

Trade Announcements.—The Imperial Electrical Engineering and Stamping Company have taken over the business of Harrison & Co., 133, High Street, Aston, and will devote themselves to the manufacture of special types of switches at their newly-fitted works, 63, Lionel Street, Birmingham.

Messrs. H. M. Salmony & Co., Limited, of Charing Cross Road, having disposed of their accessories and fittings department, announce that they have considerably increased their engineering department, and are prepared to undertake the erection of complete lighting and power plants. They will also trade in the Upton Midget enclosed arc lamps, dynamos and motors, Hart switches, Stirling railway supplies, ironclad rheostats and measuring instruments. The Sun Electrical Company, formerly trading as the Salmony Electrical Company, has purchased the fittings and accessories business referred to.

We are asked to state that the trade announcement sent to us by the Jandus Company, and published in the ELECTRICAL REVIEW for July 28th, requesting that communications should be addressed to the Hartham Road works, related only to the supply of manufacturing requirements to the company. All communications relating to the sale or working of the Jandus lamps, as also all matters relating to licenses to manufacture under royalty, should be addressed as hitherto to the company's sole agents, Messrs. Drake & Gorham, 66, Victoria Street, Westminster, S.W.

Messrs. Frederick Bamford and H. Duckworth Halstead inform us that they have entered into partnership as Bamford & Halstead, consulting, mechanical and electrical engineers, at 49, Deansgate, Manchester.

The Phœnix Dynamo Company has removed from Hubert Street, Leeds Road, Bradford, to Joseph Street Works, Bradford. The new works, which are three times larger than the old place, are more centrally situated and better adapted to the company's purposes.

Trolley Poles.—We have before us a circular of the steel trolley poles for electric car equipment as supplied by the Pittsburg Trolley Pole Company, of Pittsburg, Pa. This company manufacture poles from steel pipe of a superior quality, made especially for their purposes. They have had new machinery erected at the works recently, by which they are able under a special process to produce at one heating of the steel pipe a trolley pole complete, before leaving the machine, of uniform taper, smoothness and strength. The process is covered by letters patent, and the Pittsburg Company has the exclusive right of manufacture.

ELECTRIC LIGHTING NOTES.

Bolton.—A dispute has occurred between the Corporation and the electrical fitters in their employ. The men refused to work overtime except at special rates, and apprentices were told off to do an emergency job, but declined, and subsequently the whole of the

workmen took their tools out. As several important works are in progress, men have been introduced from other towns, principally Liverpool.

Bradford.—Mr. W. A. Ducat, Local Government Board inspector, held an inquiry last week into an application by the Town Council for sanction to borrow £37,500 for extensions of the electricity works and mains.

Brechin.—The Police Commission has agreed to transfer its provisional order to the Angus Electric Light and Power Company, Limited, Messrs. Edmundson, Limited, being guarantors, and to appoint Mr. Lackie, Glasgow, to see to the proper carrying out of the work on behalf of the town.

Bury St. Edmunds.—The Town Council is applying for sanction to a loan of £600 for lighting certain roads with electricity.

Calcutta.—We are informed by the Calcutta Electric Supply Corporation, Limited, that Mr. B. N. Sen is not chief engineer, but engineer-in-charge of the electricity works, under Mr. K. A. Scott-Moncrieff, who has been chief engineer of the company in Calcutta from the commencement.

Camberley.—The District Council is considering the advisability of applying for a provisional order, and has decided to obtain a report on the subject from an expert.

Cardiff.—The Town Council has increased the salary of Mr. Appelbee, the electrical engineer, from £300 to £350.

Cleethorpes.—The District Council is endeavouring to arrange with the Grimsby Tramway Company for a joint electricity works to supply both lighting and traction.

Cork.—The City Council has caused a large number of arc lamps of different types to be erected in the principal streets, in order to decide which kind should be adopted for the public lighting.

Dartmouth.—The Town Council has agreed to offer no opposition to the Urban Electric Lighting Supply Company in obtaining a provisional order. The Council will have the option of purchase at the end of 14 years, or any subsequent period of five years.

Devonport.—The Corporation has obtained a satisfactory site for the electricity works in East Stonehouse, and has come to an agreement with the Urban Council of that district to treat the borough and the district as one area for electric lighting purposes. The District Council agrees to oppose any application for lighting powers, save that of the Devonport authorities, so long as the latter carry out their obligations; Plymouth is therefore barred from Stonehouse, which lies midway between the two.

Dolgelly.—The question of lighting the town by electricity is under the consideration of the District Council.

Frinley.—The District Council has resolved to employ an expert to report on a scheme for lighting the district with electricity.

Glasgow.—The annual report and balance-sheet of the electricity undertaking for the year ended May 31st, 1899, shows that the gross revenue amounts to £44,141 4s. 7d., and the gross (or working) expenditure to £24,013 4s. 3d., to which is added depreciation written off capital, £7,520 18s., making together £31,534 2s. 3d., the balance carried to profit and loss account being £12,607 2s. 4d., out of which the Committee had to meet the following requirements:—(1) Interest on loans, £7,445 17s. 3d.; (2) sinking fund, £3,220—£10,665 17s. 3d.; leaving a balance of £1,941 5s. 1d., which has been placed to credit of reserve fund account. With reference to the prices to be charged for energy supplied, either for lighting or for motive power purposes during the year which commenced on June 1st last, the Committee recommend that the same should remain as they were last year, except that to all consumers supplied at 250 volts the second or rebate rate be 1½d. per unit instead of 2d. as heretofore. The quantity of electricity sold to private consumers during the past year was 2,566,016 units, as compared with 1,885,902 units during the previous year, being an increase of 36·06 per cent. The number of private consumers on May 31st, 1899, was 1,858, as compared with 1,437 at May 31st, 1898, being an increase of 421 or 29·29 per cent. during the year. There were 52 consumers who consumed the equivalent of five hours or over per day of their maximum demand throughout the year. The number of motors in use and supplied off the Corporation mains at May 31st, 1899, was 78. The total number of arc lamps erected and in regular use in the streets as at May 31st, 1899, was 227, as compared with 119 at the same date last year; and the quantity of electricity consumed for street lighting was 258,334 units, as compared with 228,134 during the preceding year. This increase would have been much greater but for the fact that the lighting of the Springburn route only came into operation in February last. The number of 8 c.p. lamps applied for, or the equivalent in other devices, as recorded on May 31st, 1899, was 191,062, as compared with 150,000 in the corresponding date in the preceding year, being an increase of 27·37 per cent. The number of units consumed, per lamp fixed, by private consumers, averaged out month by month according to date of connecting up, was 14·8, as compared with 15·17 during the previous year, the falling off being due to the curtailment of supply during last winter. The maximum load or demand made upon the generating stations during the year occurred on December 22nd, 1898, and was 3,095·9 kilowatts, which was beyond the capacity of the plant available last winter.

Glossop.—The Town Council is negotiating with private companies with a view to selling its electric lighting order.

Gosport.—The Electrical Power Distribution Company has notified the District Council of its intention to apply for a provisional order; the Council, however, has resolved to apply on its own account.

Halifax.—The Town Council has decided upon an extension of the electricity works, practically doubling the present accommodation. When completed, the new building will afford capacity for machinery of the total value of over £60,000. The extension is to be commenced at once, as the tramway developments and the increasing demand for the electric light permit of no delay.

Harrogate.—The Council decided on August 14th to extend the electric lighting station and the mains, and to purchase new plant, at a cost of £28,000. Application will be made to the Local Government Board for sanction to a loan of that amount.

Hertford.—The Corporation has resolved to dispose of its provisional order to the Municipal Electric Supply Company.

Kesteven County Asylum.—The Local Government Board has held an inquiry into the application of the Kesteven County Council for sanction to a loan of £14,000 for the erection of a new asylum near Sleaford, including £5,000 for electric lighting.

Lowestoft.—The Local Government Board has sanctioned the borrowing by the Council of £30,000 for electric lighting.

Lytham.—The District Council has accepted Mr. Tiddeman's scheme for electric lighting, as amended by Mr. Tonge, and has instructed him to prepare the necessary plans and specifications, and to invite tenders for carrying out the work. The Council has also decided to make application to the Local Government Board for the necessary borrowing powers.

Maidstone.—The District Council has decided upon the erection of a dust destructor at an estimated cost of £4,270, to be worked in conjunction with the electric lighting scheme.

Marylebone.—Messrs. Whamond, Williams & Co., accountants, have valued for the Marylebone Vestry the Marylebone electricity plant of the Metropolitan Electric Supply Company, which the Vestry is desirous of acquiring. They allow £319,735 in respect of capital expenditure, £305,283 for goodwill and other items, making a total of £643,580. On the other hand, Messrs. Delcitte, Dever, Griffiths & Co., the accountants to the company, agreeing as to £319,735 representing capital expenditure on the Marylebone section, estimate the goodwill value of the undertaking at £613,476, their total estimate thus being £933,211, hence a difference of £289,631. The Vestry will consider the report after the vacation.

Penarth.—The District Council is negotiating with the Electrical Power Distribution Company respecting the electric lighting order. The company desires an extension of the time for compulsory purchase.

Penzance.—The Town Council is considering the question of applying for a provisional order for electric lighting.

Perth (W.A.).—Electric train lighting has been introduced for the first time in the colony, on the goldfields railway.

Rhyl.—The Urban District Council on Monday passed the Electric Lighting Committee's recommendation that Messrs. Trentham & Peers prepare a scheme, report, and plans for an electric lighting installation and refuse destructor.

Scarborough.—A Corporation Committee has been appointed to consider and report upon the question of acquiring the undertaking of the Scarborough Electric Supply Company, Limited.

Stirling.—It is expected that the electricity supply will be available for the coming winter. The scale of charges will be:—For lighting, for the first 500 units per annum, 6d. per unit; for the next 500 units, 5½d.; for the next 1,000 units, 5d.; for the third 1,000, 4½d.; and for every additional unit above 3,000, 4¼d. per unit. For motive power, not exceeding 50,000 units per annum, 3d. per unit; exceeding 50,000, on terms to be arranged.

Sudbury.—The town is suffering under a gas supply at 4s. 6d. per 1,000 feet, and the Town Council is considering the question of electric lighting. As a new sewerage scheme is in hand, the engineer, Mr. Eayres, suggested that the pumps for the latter should be driven electrically, so as to dispense with a separate power station. Mr. Eayres's suggestion, we would point out, is of very great importance to the success of this and similar undertakings. It is possible to so design the pumping installation that the latter may be shut down during the hours of heavy lighting load and regulated at other times, so as to maintain a practically constant load on the generating plant. Under these conditions electricity could be supplied at a profit for 1d. or 2d. per unit.

Sydney.—The City Council is taking steps towards lighting the city with electricity, and has communicated with the Agent-General with a view to obtaining the services of an expert technical adviser.

Wimbledon.—The District Council has received a report from Mr. Preece to the effect that the original estimate of £37,000 for electric lighting had already been exceeded by £10,000, and that a further sum of £10,000 was required for immediate extensions, the plant being fully loaded.

Yarmouth.—The income for the past quarter was £1,209 15s., sufficient to pay all works' costs and capital charges, and to leave a small profit. The Council is making inquiries as to the cost of an additional 150 K.W. alternating set.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Blackrock.—A collision occurred on the 13th inst., between an electric car and a hackney car; the latter was upset, and one of the three occupants was seriously injured.

Bradford.—On August 14th a little girl, four years old, was knocked down by an electric tramcar. The child was caught on the guard, and received slight injuries.

Cheltenham.—The Town Council has approved of a new route for the tramways through the town, joining the section already sanctioned to Cleeve Hill.

Dover.—The municipal electric trams are doing excellently. The season has been very satisfactory so far as they are concerned, a record of 20,000 passengers in one day having been made.

Germany.—Messrs. Siemens & Halske, of Berlin, are preparing plans for a projected electric railway in the town of Coburg.

Glasgow.—The Tramways Committee on August 15th, on Mr. Parshall's recommendation, accepted the tender of Messrs. E. P. Allis & Co., U.S.A., for steam engines, the price being £114,554.

Ilford.—A committee, which visited Glasgow and other places, has reported to the District Council in favour of the trolley system. Mr. Hawtayne is to be asked to prepare an estimate for the construction of the tramways.

Ipswich.—The Town Council has had under consideration the question of purchasing the tramways from the Ipswich Tramways Company, at a price to be decided by arbitration. Mr. J. E. Waller, of Messrs. Kincaid, Waller & Manville, has prepared a report for the Parliamentary Committee, in which he states that the lines would require entire reconstruction for electrical working, and recommends extensions amounting to about 4½ miles. The total outlay Mr. Waller estimates at £83,000, exclusive of generating plant and feeders, which would be provided by the Electric Lighting Committee, and he recommends the combination of the lighting and traction works in one station. The Council will take immediate action in the matter.

Leamington.—The Leamington and Warwick Tramways Company is desirous of introducing electric traction, and will probably obtain assistance from the British Electric Traction Company.

Leeds.—The Corporation is about to invite tenders for 50 additional electric cars.

Liverpool.—The City Council has resolved to apply to the Local Government Board for sanction to a loan of £300,000 for electrical purposes.

A serious accident occurred on August 13th, at 9.30 p.m.; a bus which was turning the corner of Crown Street into Upper Parliament Street was run into and overturned by an electric tram proceeding in the direction of Smithdown Road. The collision, which occurred without warning, caused great consternation among the passengers, who were scattered in all directions, and several of them sustained serious injuries.

London.—In a communication to the *Daily Graphic* last week, Mr. Holroyd Smith suggests that while the County Council is laying conduits for the electric tramways south of the Thames, it may as well go further, and construct a large subway under the track to accommodate the various gas, water, and electric mains. For this purpose, he would place the slots in the two rails nearest the centre of the roadway instead of in the middle of each track as is usual, so as to bring them over the subway. The idea is attractive, but would involve an immense expenditure, and we do not expect that it will go any further.

Plymouth.—Sanction has been received by the Plymouth Corporation to their proposal to borrow £18,000 for the reconstruction of the Compton section of their tramways and the equipment of them for electrical traction. The Tramways Committee have decided to invite tenders for the supply of rails and bonds with a view to the early commencement of the work, which, however, will not be completed until a scheme for widening part of the roadway, which is now in progress, has been carried out. A further extension of the eastern section of electrical tramways is to form the subject of an application for a provisional order next session.

Portsmouth.—On the 10th inst. Mr. F. J. S. Hopwood, C.B., from the Board of Trade, sat at Portsmouth to hear an objection of the Portsmouth Corporation in respect to a light electric railway from Cosham to Horndean, to cross Portsdown Hill. It was stated that the War Department was in favour of its construction for military purposes, there being forts on the hill, where it is intended hereafter to erect a military hospital. The scheme was passed by the Light Railway Commissioners, after an inquiry which was presided over by the Earl of Jersey. The Portsmouth Corporation has obtained powers to take over the Portsmouth tramways, and it objected to the terminus of the light railway being made at a narrow part of the road leading out of Portsmouth, on the ground that it would be dangerous to passengers, as there was a good deal of road traffic there. After hearing statements on either side Mr. Hopwood suggested that the parties might agree upon a temporary arrangement, with a view of making a junction between the tramways and the light railway. The War Office and another public department were anxious to see the light railway constructed at an early date, as it would be useful for military purposes. He should advise the Board of Trade on the matter and communicate the result to the parties, who he thought might easily arrange their differences.

Sunderland.—The Corporation Tramways Bill has received the Royal assent, and the Council has agreed to purchase the undertaking from the Sunderland Tramways Company at a cost of £35,000. The whole of the old and new routes are to be electrically equipped by August 31st, 1900, the total expenditure being estimated at £126,618. The estimate of the electrical engineer, Mr. Snell, was £120,600—a very good approximation. The contract has been placed in the hands of Messrs. Dick, Kerr & Co.

The New York Elevated.—According to the *American Electrician*, the Manhattan Railway Company, in July, decided to place a contract with the E. P. Allis Company, Milwaukee, for 8 8,000-H.P. engines, capable on overloads of developing 100,000 H.P. The company had already selected a location for a power house and placed a heavy order for third rails. These engines will be by far the largest ever used for driving electrical generators, having just double the capacity of the 11 4,000-H.P. sets now under erection for the Metropolitan Street Railway Company, New York City. The power station of the elevated will have exactly the same capacity as that planned for the Third Avenue Railroad of New York City, for which 16 4,000-H.P. units were proposed.

Westbury.—The Bristol Tramways Company, Limited, in response to a petition from residents, has promised to obtain powers for extensions to Westbury at the next opportunity.

York.—The Tramways Company applied to the City Council some time ago for leave to adopt electric traction; the Council has now decided to open negotiations with the company with a view to purchase.

TELEGRAPH AND TELEPHONE NOTES.

African Trans-Continental Telegraphs.—The report of the Commissioners of the British Central Africa Protectorate for the year ended March 31st, of which a lengthy summary appears in the *Times* for Tuesday last says with regard to the Trans-African telegraph:—

The African Trans-Continental Telegraph Company have proceeded steadily with the construction of their line to the north, which is now completed to a point close to the south end of Lake Tanganyika. By the time this report reaches England the line will have been formally opened up to Tanganyika. A branch line is now in course of construction from Domira Bay, on the west shore of Lake Nyasa, to Fort Jameson, the headquarters of the British South Africa Chartered Company in Mpeseni's country. With regard to the extension northward of the African Trans-Continental Telegraph Company's line from the south end of Lake Tanganyika towards Uganda, I am informed by the company's representative that a steamer of considerable size has already been ordered in England for Lake Tanganyika, to be used both for the transport of telegraph material from the south end of that lake to various points on its eastern shore, and also for telegraph purposes after the construction of the line is completed. The telegraph company have now a large number of native operators, and they find that the educated African, as turned out by the various missions in the country, takes readily to telegraph work. Dr. Laws, the head of the Free Church of Scotland Mission in the Nyasa districts, has established a short line of telegraph at the Kondowe Mission, and has a special class of natives who are trained for this work. By thus using native telegraph operators it will probably be possible in future to carry on the work of the African Trans-Continental Telegraph Company's lines with only a very moderate number of European employés. From April 1st, 1898, to March 31st, 1899, 176½ miles of line were constructed and strained—*i.e.*, from Kota Kota to 44 miles beyond Karonga. Blantyre is now in direct communication with London *viâ* Cape Town on the one hand, and with the most northerly part of Lake Nyasa on the other. A Belgian expedition, under the command of Mr. Mohun, passed through the protectorate in the commencement of 1899 for Tanganyika, its object being to erect a telegraph line from a point on the west shore of Lake Tanganyika to the Congo river. A German expedition also passed through with material, &c., to place a new steamer on Lake Tanganyika.

Bradford Telephones.—The Bradford Corporation last week held a special meeting to consider the question of giving notice to the National Telephone Company to determine the agreement as to wayleaves between the Corporation and the company, dated August 20th, 1896. A resolution to that effect was passed, and the town clerk was instructed to carry out the necessary steps.

Congratulations.—We are glad to observe that Don Primitivo Vigil y Lopez Losada, who has on several occasions represented Spanish Government interests during the laying of submarine cables by English companies, has recently been promoted to the position of "Director de Seccion" of the first class.

Glasgow Telephones.—The Corporation Telephone Committee, on 15th inst., agreed to recommend that application should be made for a license to establish a Corporation telephone system in the city.

Gutta-Percha and India-Rubber from Nigeria.—In the course of a series of interesting articles on Nigeria the *Pall Mall Gazette* gives us the following information:—"After ivory, rubber must lay claim to our attention as an important article of Nigerian trade. The white, sweet-smelling flowers of the rubber vine are one of the commonest sights in the forest of Nigeria. Unlike ivory, of which the output is on the decline, the trade in rubber will assuredly grow to large proportions as soon as the advent of competitive commercial enterprise into the Niger and the consequent increased demand for European merchandise on the part of the natives has provided the necessary stimulus for its development. At present the transactions in this product are, comparatively speaking, small. But both trees and vines (*Kickxia africana, Landolphia ovariensis*, &c.) exist in plenty throughout a large proportion of the Niger territories,

and only require intelligent working—in which the attractions of immediate gain must not be permitted to spoil future prospects, as has been the case elsewhere—to yield good results. Bearing in mind the gigantic growth of the rubber industry in Lagos, the Gold Coast, French Guinea, and the Congo during recent years, there is every reason to hope and believe that, with stringent regulations against wholesale tapping, the Nigerian rubber trade will ere long become very considerable. Gutta-percha is as valuable an article of commerce, and as greatly in demand for European manufactures, as rubber itself. In Nigeria gutta-percha is collected immediately the rainy season is over, the sap at that time of year flowing more freely from the tree. In coagulating, the milk assumes a reddish tinge."

Imperial Telegraphs.—A *Times* special despatch from Simla "by Indo-European Telegraph," dated August 13th, says:—"Referring to Mr. Henniker Heaton's article in the *Times* of July 13th, and his assertion that the Indian telegraph lines may be carried across Afghanistan to Merv or Teheran, the Ameer having already sanctioned the erection of lines to Kabul and Herat, I have the best authority for stating that the Government of India are unaware of any such sanction having been given; also that Sir Edward Sassoon's belief that 'Lord Curzon had gone the length of recommending the alternative route known as the Russo-Chinese route,' for an Asiatic international telegraph is totally mistaken. The Viceroy never countenanced or authorised the expression of any such opinion. Finally, regarding the linking up of the Mergui telegraph with Singapore *vid* the Malay States, which Mr. Henniker Heaton and Sir E. Sassoon apparently regard as a simple matter, it is necessary to point out that the Indian telegraphic authorities hold a very different opinion. They believe that the construction of such a line would be very difficult and costly, and the expense of maintenance may be judged by the fact that while the cost per mile in India is Rs.11 or Rs 12, the Tavoy-Mergui line costs about Rs.25 per line of wire. It is estimated that a line from Mergui to the Malay States and Singapore would cost from Rs.30 to Rs.35 per mile.

Telegraph Engineers in Conference.—The fourth annual conference of the Amalgamated Association of the Postal Telegraphs Engineering Department was held in the Grand Hotel, Cardiff, on Monday. Delegates were present from London, Manchester, Liverpool, Birmingham, Northwich, York, Selby, Nottingham, Newcastle-on-Tyne, Sunderland, and Cardiff.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Amazon Company's cable—		
Cable beyond Gurupa ...	April 4th, 1898 ...	...
Bonny-Cameroon	May 29th, 1899 ...	...
Latakia-Cyprus	June 20th, 1899 ...	...
Para-Maranham	April 10th, 1899 ...	...
Maranham-Ceara	July 25th, 1899 ...	August 15th, 1899
Medan-Olehleh	July 31st, 1899 ...	August 4th, 1899
Accra-Grand Bassam... ...	August 1st, 1899 ...	...
Corea-Japan	August 7th, 1899 ...	...
Iquique-Valparaiso	August 15th, 1899...	...
Florida-Bahama	August 14th, 1899...	August 16th, 1899
Jamaica-Colon	June 30th, 1899 ...	...
Jamaica-Porto Rico (Ponce)	August 15th, 1899...	...
Jamaica-Porto Rico (San Juan)	August 15th, 1899...	...
Landlines.		
Communication between Salonika and Monastir ...	March 23rd, 1899 ...	...
Communication between Bolama-Bissao	July 28th, 1899 ...	...
Dominica Landlines ...	August 10th, 1899 ...	August 14th, 1899

The Telephone Service.—In the House of Commons last week, Mr. Channing, for Sir James Woodhouse, asked the Secretary to the Treasury, as representing the Postmaster-General, whether any terms had been agreed upon with the National Telephone Company as to inter-communication between the subscribers of that company and the subscribers of any competitive telephonic systems which might be set up under the provisions of the Bill now before Parliament when they should come into force; and, if so, whether he would state what those terms were.—Mr. Hanbury said if the subscribers of any competitive telephone system equalled one-half the numbers of subscribers to the National Telephone Company, then inter-communication would be free over and in the restricted area of the new licensee, or, if they numbered one-half of the whole area they would also be free. If they were equal to one-quarter and less than one-half, a charge of one penny would be made.—Mr. Provand asked what the terms would be if the number were less than one-quarter.—Mr. Hanbury replied that where the subscribers were less than one-fourth there would be a rate of three-halfpence charged for inter-communication. These cases would be extremely rare, because he certainly would not advise the Post Office to grant a license except there was a *bonâ fide* competition, which would not be the case where the subscribers were less than one-fourth.

The "All-British" Cables.—On the 10th current the Legislative Assembly of Victoria adopted a motion brought forward by Mr. Duffy, the Postmaster-General, to the effect that Victoria should join the Pacific cable scheme. One of the members urged the superior advantages of the Cape cable offered by the Eastern Extension Company, but Mr. Duffy stated that Victoria was committed to the support of the Pacific cable and it was impossible to withdraw. Mr. Gillies strongly supported Mr. Duffy, whose motion was carried by acclamation.

In Ottawa, in the speech from the Throne on the occasion of the prorogation of Parliament on the 11th, the Governor General of Canada, said: "I am glad to observe that the action of Canada in deciding to unite with the mother country and the Australian colonies in the construction of a Pacific cable has met with general approval. I congratulate you on the evidence of continued prosperity that prevails in all parts of the Dominion, and which has stimulated the formation of so many companies having for their object the development of enterprises that must tend to increase the wealth of the country." The speech concluded with the expression of a hope that Canada would long continue to enjoy the prosperity that at present prevails.

Cable Rates to South Africa.—A Reuter despatch from Cape Town says that on September 1st next the cable tariff between England and all stations in South Africa, including places in the Free State and the Transvaal, will be reduced to 4s. per word.

The West Indies Hurricane.—The Halifax and Bermudas and the Direct West India Cable Company have placed their cables at the disposal of the Lord Mayor, free of charge, for any messages relating to the Mansion House Fund. Both cables between Jamaica and Porto Rico, belonging to the West India and Panama Telegraph Company, are interrupted. This, without doubt, is due to the effects of the hurricane. It is understood that repairs will be effected before the end of this week. After having passed over Turk's Island, where no damage was done, the hurricane made itself felt in the Bahamas, the cable to those islands being also interrupted.

The West Indian Cables.—A Washington telegram to the *Standard* says:—"It will be recollected that Mr. Alger, when War Secretary, and other authorities, sustained the Western Union Telegraph Company's concession, which gives that company, with the British connections, a monopoly of West Indian telegraph business, *viâ* Cuba. But Mr. Root, his successor, will reopen the question, and will submit it to the President. He will take this action upon the opinion of Senator Edmunds, supporting the Commercial Company's claim to a right to land a cable upon its private premises in Cuba—a course now prevented by the military authorities alone.

Wireless Telegraphy.—The *Standard* says that the Admiralty have called for a report from the commanding officers of the battleship *Alexandria* and the cruisers *Europa* and *Juno* on the advantages and general results of the use of wireless telegraphy on board those vessels during the naval manœuvres. The Admiralty are so satisfied with the experiments made with the Marconi system during the naval manœuvres, that they have ordered a complete set of the apparatus to be supplied to the Torpedo Schoolship *Defiance* at Devonport, where further experiments will be tried under the direction of Commander W. C. M. Nicholson, who has made a special study of the system.

CONTRACTS OPEN AND CLOSED.

OPEN.

Aberdeen.—August 21st. The Electric Lighting Committee wants tenders for a 12 months' supply of house service and lead covered distributing cables. See "Official notices" August 11th.

Barnsley.—September 16th. Tenders are wanted for electric light wiring and fittings at the Harvey Institute, Eldon Street, for about 700 lights. See "Official Notices" this week.

Battersea.—August 31st. The Vestry wants tenders for an overhead travelling crane (hand or electric), and batteries for the electricity works. See "Official Notices" July 7th.

Battersea.—August 31st. The Vestry wants tenders for steam pipes, pumps, condensers, economiser, tools, &c., also switchboard and booster. Specifications at the office of Prof. Kennedy, 17, Victoria Street, S.W.

Birkdale.—August 19th. The Urban District Council invites tenders for the transfer of its electric lighting powers.

Blackpool.—August 21st. The Corporation wants tenders for 10 double bogie tramcars. See "Official Notices" July 28th.

Carlisle.—September 11th. The Corporation wants tenders for extension to steam, drain, and feed pipes, feed pump, and extension of economiser at the electricity works. See "Official Notices" this week.

Darwen.—August 22nd. The Corporation wants tenders for rail bonds. See "Official Notices" August 4th.

Devonport.—August 31st. The District Tramways Company invites tenders for the following contracts: Permanent way, road bed, paving and bonding of about 4½ miles of double line, overhead construction for about 4½ miles of route. See "Official Notices" August 11th.

Dundee.—August 23rd. The Council wants tenders for the overhead line equipment and rail bonding of the Perth Road and Lochee tram routes. See "Official Notices" August 4th.

East Ham.—September 9th. The Urban District Council wants tenders for combined electric light and traction plant, engines, generators, overhead line equipment, cars, switchboard, arc lamps, &c., water-tube boilers, condensers, and other steam plant, electric light cable. Mr. W. C. Ullmann, The Limes, White Post Lane, East Ham, is the Council's electrical engineer. See "Official Notices" August 4th.

(*Continued on page* 279.)

A "FIN-DE-SIECLE" MACHINE SHOP.

By FRED. BATHURST, A.M.I.E.E.

To English readers the above title would, under present conditions, suggest that this article deals with a recently installed American factory, or else an English workshop re-modelled on American lines and equipped with the latest types of American tools, since for up-to-date machine shop lay-out with scientific and economic production, it is only too seriously true that at the present moment we have to look to U.S. practice for the best examples.

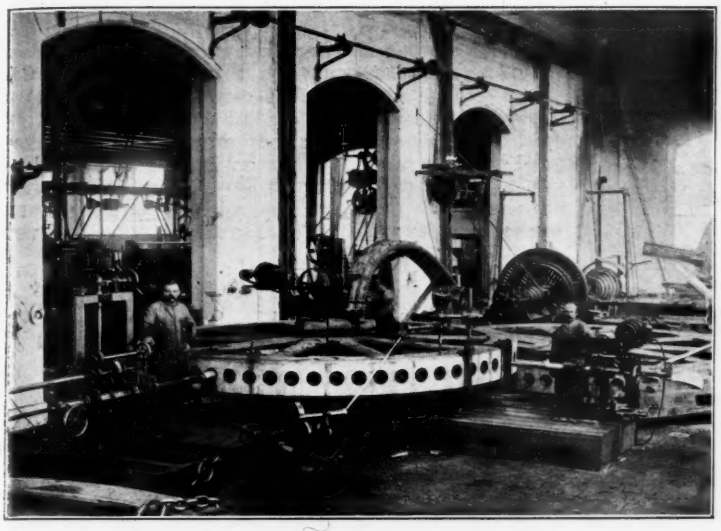


Fig. 1.

It is with pleasure, therefore, that one finds in the centre of Europe, at Prag-Vysocan, in Austria (midway between Vienna and Berlin), the dynamo machinery factory of Kolben & Co., or, to give it its full Bohemian title, the "Elektrotechnická Akcrová Spolecuost drise Kolben a Spol." It is thought the following description and illustrations of machines found in this shop will prove that there is near at hand at least one instance of as perfect a combination of European and American workshop practice as can be desired.

In describing a modern machine shop, designed for the purpose of manufacturing all sizes and types of dynamo-electric apparatus, it is only to be expected that we should find the advantages of electric power transmission fully appreciated, although rarely so fully and completely utilised as in this particular instance. An up-to-date factory manager having to consider the question of alterations or extensions to an existing plant, must by this time thoroughly recognise the advantage and economy arising from the use of electrical transmission of energy by means of small flexible and easily installed copper wires, instead of following the old-time practice of power transmission with its shafting and belting from the main engine, necessitating fixed and heavy runs of steel shafting with a consequent limitation as to the design of the shop and the position of the machine tools.

With electric transmission the shops can be arranged:—

1. Just as required in the natural process of production and without regard to the lay-out of the building.

2. Extension can be effected and additional machines laid down in any direction without any regard to driving power and the shafting runs.

3. Great saving in the wear and tear of the driving shafting (oftentimes from 30 to 60 per cent. of the total power required in the factory) can be effected by applying electric power direct to the larger or special portable tools, whilst smaller machines are separately driven in groups from short lengths of countershafting.

Thanks to the high state of development and mechanical perfection that has been reached in respect to continuous current motors and generators, many factories can now be found in which the above advantages have been seized upon, and descriptions of such plants are no longer new.

The plant of Kolben & Co., although comparatively small by reason of its exceptional design in respect to the horse-power required, is a unique and up-to-date exemplar of three-phase current electric power distribution, a type of practice which has been comparatively neglected in England until recently. The writer's opinion is that examples of three phase work in England have been few, and our electricians have not acquainted themselves sufficiently with foreign and Continental practice, so

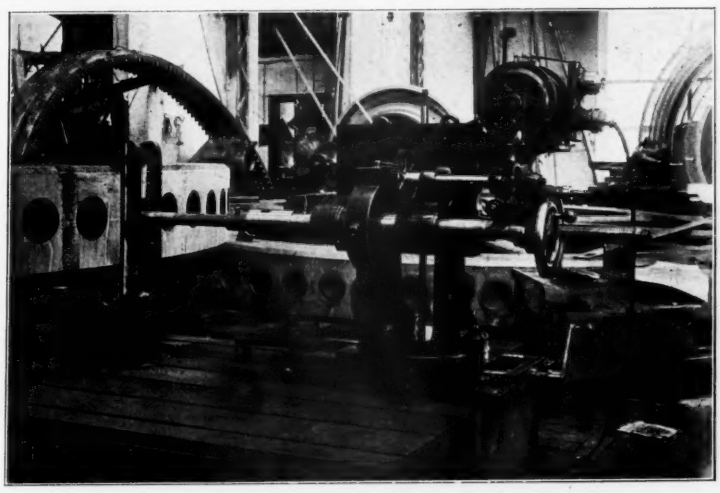


Fig. 2.

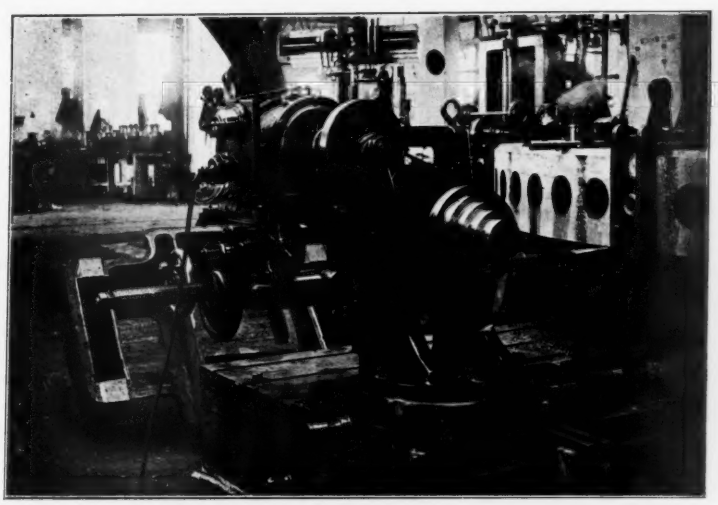


Fig. 3.

that they have failed to appreciate the advantages and possibilities of this system of electric supply.

The approaching visit of the I.E.E. to Switzerland may, it is anticipated, offer an opportunity of seeing the successful and practical use of three-phase plants, and will doubtless lead to their more general development in England.

It may, however, be taken for granted at once that, for any power installation requiring a number of motors for varied applications, and where the total capacity required amounts to 100 H.P., under most conditions a three-phase plant will be found more economical both in first cost

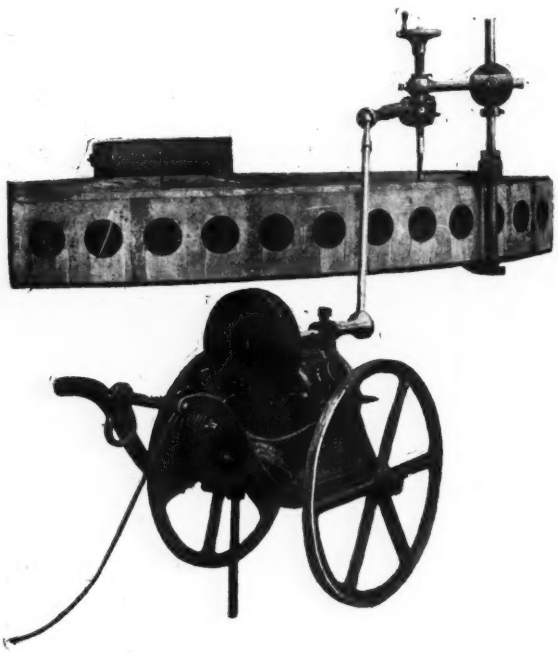


Fig. 4.

and in maintenance than a continuous current installation. The comparative absence and unimportance of the motor starting and regulating boxes, and the greater impunity with which the three-phase motors can be handled by unskilled and non-technical workmen alone counts greatly in favour of this system, but this point is best brought home by actually seeing a few plants in operation rather than by discussion.

Having determined the prime source of power, and chosen the method of distribution by which the power is to be advantageously applied, the factory manager, in order to reach an ideal lay-out, has to provide high-class tools which will give

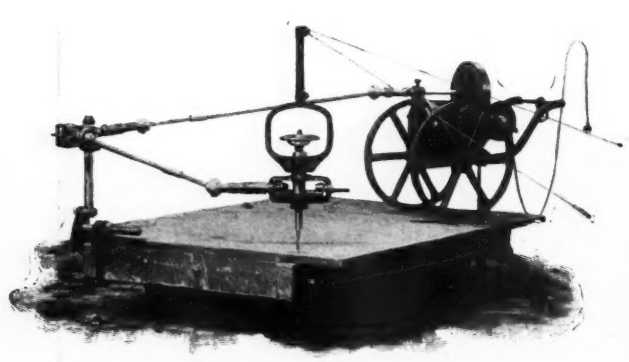


Fig. 5.

a large output at low cost production and within a minimum of time. The work provided must employ each tool upon its standard work for as many hours as possible during the working day so that the tool may fully earn the interest on its first cost. Floor space must be occupied as economically as possible.

It is problems such as these that Herr Emil Kolben set himself to work out in connection with this factory. Probably very similar conditions present themselves in almost every factory, but certainly in a rapidly-growing and developing industry like that of dynamo machine manufacture, although the utmost care and discretion may have been exercised in the selection and arrangement of the tools, a time comes when the castings and parts to be operated upon grow too large for the existing appliances, and the management has to face the solution of newer and more difficult problems. It is in meeting this condition that the works of Kolben & Co. appear to have attained most complete success, so that to-day this factory must be counted amongst the few that can readily undertake and execute any and all classes of electrical work that can be called for or that progressive development may dictate. The unexpectedly rapid increase in kilowatt capacity of the generators required for electric light and traction work brought into the shop heavier and still heavier

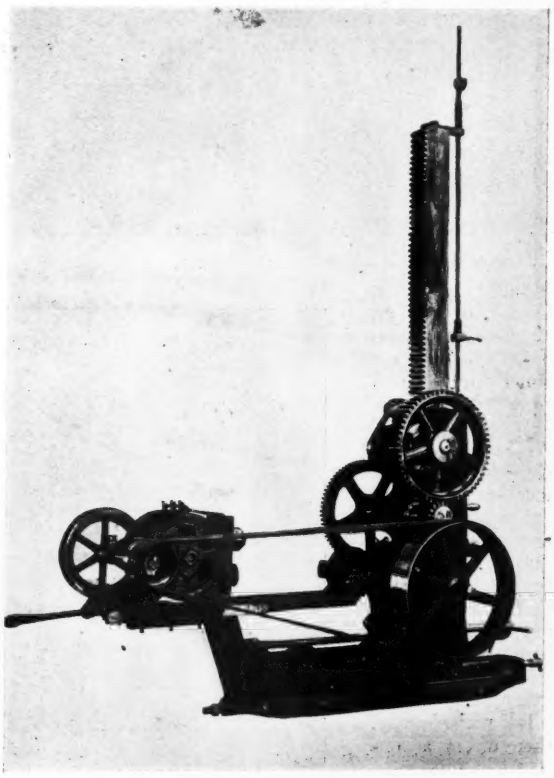


Fig. 6.

castings, whilst the adoption of the fly-wheel type of multipolar generating machines so increased the size and shape of the castings handled as to necessitate an almost complete reversal of the practice the shop had been laid out to meet.

The castings grew larger and larger until they reached the practical limit for satisfactory handling. When castings of fly-wheel shape grew from 2 and 3 feet to 12 and 20 feet diameter, and increased in weight from 4,000 lbs. to 80,000 lbs., it was found easier to bring the tools to the work, instead of taking the work to fixed tools.

The main object of this article is to bring the illustrations and descriptions of these specially designed portable tools before the readers of the Electrical Review, so as to show the comparative ease with which a machine shop can be re-equipped, to enable it to undertake the production of machines of the largest size with a comparatively small fresh outlay of capital. Incidentally, also, it will be noticed how completely and efficiently three-phase motors of any size can be applied to meet the requirements of machine tools.

Fig. 1 shows four processes, *a*, *b*, *c*, *d*, being carried on at one and the same time upon a 16-foot diameter magnet wheel (weight 46,000 lbs.), designed for use in a 1,000 H.P three-phase alternating current generator.

The illustration sufficiently indicates the difficulty that would be entailed in handling such a large-sized piece of work, if it had to be taken from tool to tool for each process, and by comparison shows how conveniently the small portable self-contained motor tools can be arranged around it, so that horizontal drillings in two sizes, side drillings, and key seating operations can proceed together.

Instead of choosing a position with respect to the countershafting available for tool driving, the casting is dropped down anywhere in the shop, and a flexible electric cable brought to the motor of the portable tool from the nearest wall plug. In this particular case, the work has been placed so that it can be operated upon (process *a*) by a fixed horizontal boring tool (shop-driven by a 6 H.P. three-phase motor) which has to make the 64 12-inch diameter holes for the magnet cores. By arranging three other portable tools around the casting, economy of floor space, as well as of labour, naturally follows, and although three workmen can be seen in the picture, only two are needed to tend the four tools at work.

Figs. 2 and 3 show in detail the tool by which (process *b*) the side boring of a hole 2½ inches in diameter inside the 12-inch hole in the cast-steel frame is carried out. This portable horizontal boring machine weighs, complete with motor, only about 900 lbs., its approximate overall dimensions being: height, 3 feet; width, 2 feet 6 inches; length, 4 feet 6 inches without boring tool.

The machine is arranged on a base plate, which can be clamped or bolted to the shop floor or a convenient tool bed. The body of the machine is mounted on a sliding bed in such a manner that it can swivel completely around or move along it, so that the boring mandrel can be readily faced up toward or adjusted to the work. A three-phase 1-H.P. motor bolted to the frame casting provides sufficient driving power, a cone pulley on the motor shaft driving by belt a counter cone, which is connected through screw gearing to the boring shaft. The gearing can be thrown in or out by the workman as he desires, whilst the boring shaft has a self-governing screw feed. With this machine holes of any size up to 3 inches diameter can be readily bored out. The approximate cost of the complete tool is about £70.

Fig. 4 shows the detail of the Universal portable truck drill which is seen at work in fig. 1 (process *c*), making a side hole for a 1-inch bolt. This tool weighs, complete, about 650 lbs., and, including the waggon, has overall dimension as follows: Height, 2 feet; width, 2 feet; length, 3 feet 6 inches. When fitted complete with flexible shaft, drill holder outfit, connecting cable and winding drum, its cost is £80.

It consists of a two-wheel carriage supporting a 1-H.P. (three-phase or other type) motor driving by single reduction a geared countershaft which operates the flexible shaft. The whole machine is balanced in such a manner that when it is necessary to do drilling at a height more than 5 feet from the ground (the limit of the flexible shaft), as may be required for the inside of large generators (or in another condition, as for roof or bridge work), the whole tool is swung into the air by means of a crane, and the drilling shaft remaining horizontal, drilling can be proceeded with in this position. Holes up to 1½ inches diameter can be made by this machine.

Experience proves that the possibility of operating this machine whilst it is suspended in mid-air is very useful in the case of large generators, the necessary hole being made whilst the work is *in situ*; without such apparatus the work would have to be laid over on its side upon the floor of the shop, and brought with difficulty under the ordinary drilling press. It is obvious that this truck drill when fitted with a special head-piece can be most usefully employed inside boilers or similar hollow work, as well as finding an invaluable application in respect to flat tablets and marble slabs used in electric switchboard work. The latter application is shown in fig. 5.

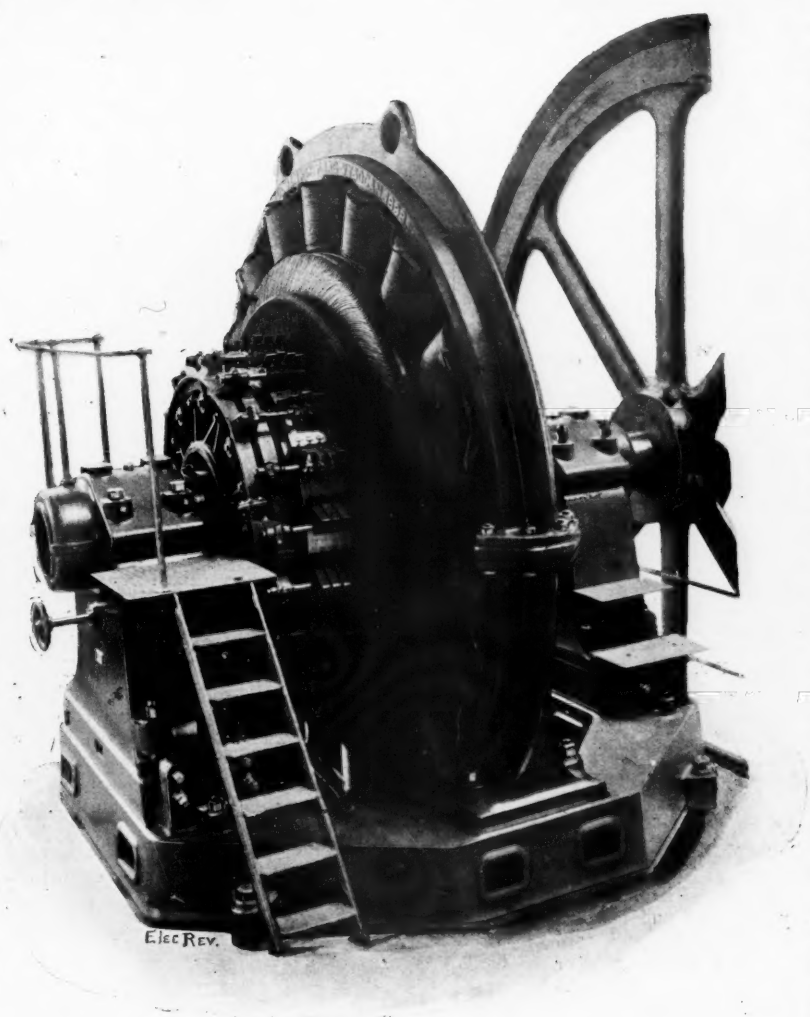


Fig. 7.

Fig. 6 shows in detail the American type of key-seating machine, driven by its self-contained ½ H.P. three-phase motor, which is carrying out process *d* in fig. 1. This portable combination tool, weighing about 1,800 lbs., is one of the most useful machines to be found in Kolben & Co.'s shops. Whilst dynamo manufacturers in England are mostly employed upon two, four, and six-pole generators, having comparatively high-speed small diameter armatures, Continental practice in respect to generators for outputs above 200 KW. has developed through "many poles," until to-day the most favoured type is a direct-connected slow speed bar-wound armature of large diameter, enclosed by a field magnet often containing 20 or more poles (see fig. 7, showing the design of a 400-KW. continuous current generator running at 90 revolutions and having 18 poles). This constant increase in the diameter of the armature required a continual increase in size of the swinging arm of the slotting machines necessary for cutting

the key-way for the engine or driving shaft, until the limit of a practical tool was reached.

The race between the size of the work and the tool required for it, having been decided in favour of the work, we now find this comparatively small tool, having overall dimensions, height 8 feet, width 3 feet, length 6 feet, uniformly employed upon all the larger size pulley or wheel-shaped castings required for armature spiders. The portable

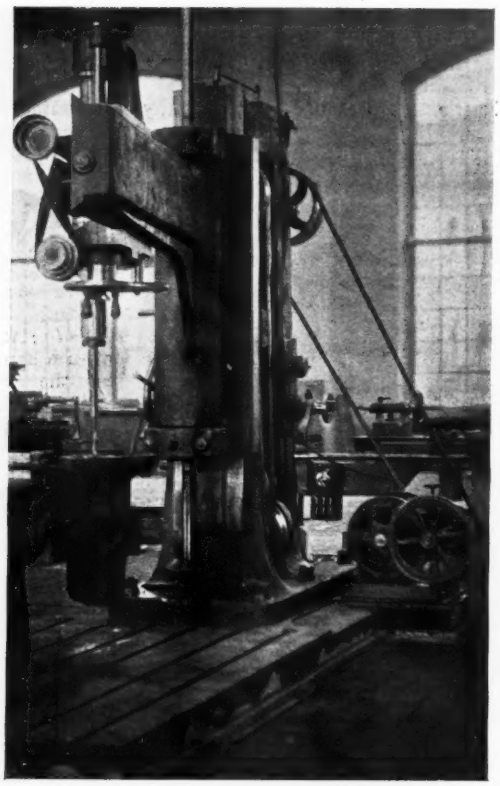


Fig. 8.

tool has the advantage that the shop crane readily transports it to the particular casting to be operated upon, and being fixed in position thereon, the key-seating process can proceed at the same moment as, and without hindrance to, other essential operations, making a great saving and convenience in the handling of the castings, as well as permitting a saving in the time required for finishing them.

Instead of the practice usually followed in slotting machines, by which the tool head in making the cut is forced downwards into the work with the tendency to compress or bend the tool holder out of position (necessitating considerable stiffness and strength of tool arm and body), advantage has in this case been taken of the general lightness of the design (required for portability) to reverse the action of the tool, and employ the tool head as a *draw bar* under tensile or pulling stress instead of under compression. A special clutch gearing is also used, so that the tool returns from its work four times as fast as its normal cutting speed, this movement, as well as the feed, being provided for automatically.

The ½ H.P. motor is provided with single reduction gear and belt drives on to the tool mechanism, so that the slip of the belt partially compensates the strain on the tool mechanism, as the tool enters or leaves its work. The motor being mounted on a sliding baseplate, a belt tightening attachment provides any desired adjustment. This tool cuts a key-way in shaft bores of any size from 4 inches to 20 inches diameter, as deep as necessary, from ¾ inch to 4 inches wide. The approximate cost of such a tool complete is £200. It is obvious that such a convenient tool has a wide range of application in other machine and metal working shops.

Fig. 8, showing a radial drill driven direct from its independent shop motor can be advantageously referred to at this point, as showing the difficulty that the ordinary drilling as well as keyseating tools present by reason of their clumsy overhanging swinging arms. After seeing in operation the drilling and boring tools shown in fig. 1, no one will want to arrange a large casting of awkward shape underneath tools of the swinging arm type. The tool shown has a 7-foot swinging area, and is belt-driven through single reduction gearing by a 3-H.P. motor secured to the same bedplate. This tool is now relegated to its proper use, that of drilling holes up to 3½ inches diameter in large base plates or other flat castings of large area. At the back of the drill part of the tool head and bed of a small lathe may be seen, together with the simple starting and regulating switch, by which its self-contained three-phase motor is controlled.

Fig. 9 gives a good idea, by comparison with the relative size of the men at work within it, of the diameter of the pieces of work that are being dealt with in the Kolben factory. It illustrates the assembling of the stationary armature for a three-phase 1,000 H.P. generator. This armature frame is 19 feet inside diameter, and has a finished outside diameter of 25 feet. Its approximate weight (finished) is 60,000 lbs., whilst the generator, assembled complete, weighs 140,000 lbs. These figures may be considered sufficiently eloquent in themselves to save allusion to the fact that it is better to let such pieces remain on the shop floor as much as possible in one position, and bring portable tools to them, rather than endeavour to take them around the shop to large fixed tools. The four men seen within the ring have their hands fairly full of hard work, for they have to assemble 26,000 lbs. of thin sheet iron, consisting of 11,500 segments (seen as sectional stampings), and the winders, who occupy their position later, have to handle a considerable weight of copper in arranging in the 384 peripheral (slotted) holes, 192 carefully insulated coils. Always having a thought towards the saving of floor space, it is no uncommon sight in this shop to see two, or even three, of these armature frames being assembled one within the other, and yet find that the nine or ten men employed have plenty of working room.

A further note in connection with the assembly of this armature may be of interest to English manufacturers who are still mainly in the "japan pasting," or perhaps in the "paper punching" stage. In ordinary practice, the 11,500 iron segments would have to be assembled with an equal number of separate and similar tissue paper punchings, the work of assembling these frail sheets being really more trying and fatiguing than the iron segments. In fact, the difficulty and annoyance arising from the paper sheets has convinced many designers that equally good mechanical and magnetic "insulation" can be obtained with a japanned disc, in

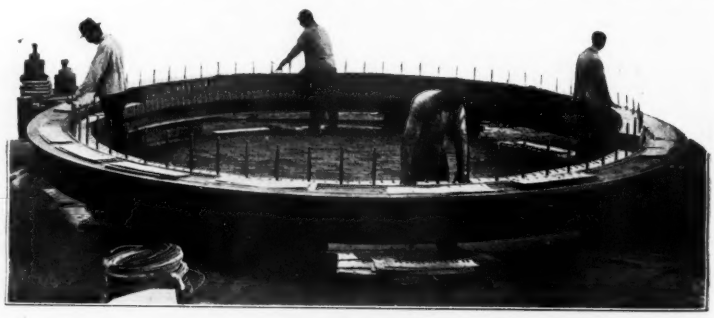


Fig. 9.

spite of the incidental difficulty of effective painting and drying. Careful and complete tests have convinced the engineers of the Kolben Works that "paper" separation is to be preferred, provided always that wood-pulp tissue paper, which will bear subjection to great heat and pressure without charring, is chosen. The difficulty and extra time required for stamping and assembling the paper has been overcome by designing a machine which pastes every sheet

of iron with a complete facing of paper, so that the one punching operation for making the sections cuts out the stamping ready papered for assembling. With this machine, a modified form of printing press, two men can in a 10 hours' day cover 6,000 feet of iron sheeting 4 feet 6 inches wide without any difficulty. The immense saving of labour which this machine effects is further supplemented by advantages which follow in assembling, for with pasted sheet armatures the holes or slots in the disc or segment, line up quite truly without the necessity of "gouging out," and leave a larger and truer space for the winding, permitting a considerable percentage increase either in copper cross-section or for the insulation of the wire or bars.

(To be continued.)

CONTRACTS OPEN AND CLOSED.

OPEN.

(Continued from page 274.)

Germany.—Tenders are at present being invited by the Frankfort-am-Main Municipal Tramways Committee for the supply of 200 steel tyres and 40 sets of wheels and axles for electric tram-cars. Tenders to be sent to the Betriebs Direction der Städtischen Strassenbahn, Frankfort-am-Main (Bockenheim), whence particulars may be obtained.

Glasgow.—August 21st. The Corporation wants tenders for the supply of switchboards, copper bus bars, and electricity meters. See "Official Notices" August 4th.

Hackney.—September 12th. The Vestry wants tenders for four sets of direct current steam dynamos (either high or low speed). See "Official Notices" August 11th.

Hampstead.—The Vestry invites tenders for the extension of its electric lighting station, and is spending £30,000 on new machinery there.

Ilfracombe.—September 25th. The District Council wants tenders for boiler plant, engine plant, dynamos, condensers, switchboard, mains, lamp-posts, accumulators, meters, crane, buildings, &c. See "Official Notices" this week.

Ingleton. — The Ingleton Electric Light and Power Company wants tenders for the supply of dynamos, switchboards, batteries, and wiring. See "Official Notices" August 4th.

Leeds.—August 30th. The Tramways Committee wants tenders for the electric lighting of the car sheds, Kirkstall Road. See "Official Notices" this week.

Malmo.—September 1st. The Gas Works' directors want tenders for the erection of electricity works for the city. Particulars on application to the clerk of the Gas Works (deposit 12s).

Manchester.—August 23rd. The Baths, &c., Committee is inviting tenders of an electric light installation for the new Islington Baths and Public Halls. Specifications from the general superintendent, Osborne Street Baths.

Motherwell, N.B.—August 18th. The Commissioners invite tenders for machinery and works in connection with the proposed electric lighting of their town. See "Official Notices," July 28th.

Perth.—August 28th. The Commissioners want tenders for boilers, condensers, steam dynamos, switchboard, underground mains, and accessories. See "Official Notices" July 28th.

Poplar.—September 6th. The Guardians wants tenders for high speed engine and dynamo, electric motors, Lancashire boilers, economiser, and other plant, as briefly particularised in our "Official Notices" this week.

Portugal.—September 6th. Tenders are being invited by the municipal authorities of Cascaes, Portugal, for the concession for the electric lighting of the town.

St. Annes-on-the-Sea.—September 11th. The Council wants tenders for high speed engines, continuous current dynamos, and balancing booster, for electric lighting. See "Official Notices" this week.

St. Mary, Battersea.—August 31st. The Vestry wants tenders for steam pumps, pipes, condenser, economiser, &c., switchboard, and boosters. See "Official Notices" July 28th.

Southport.—The Corporation wants tenders for the supply and laying of tram rails, points, crossings, bonding, permanent way; also overhead equipment, including poles, wires, &c. See "Official Notices" August 11th.

Sunderland.—The Corporation wants tenders for four 270-kw. three-crank direct current steam dynamos, and two surface condensers and cooling tower. See "Official Notices this week.

Sydney (N.S.W.).—November 3rd. The Municipal Council of Sydney is inviting tenders for the construction and erection of a refuse destructor for treating 60 tons of refuse per day (24 hours).

CLOSED.

Bootle.—The Town Council has placed a contract with Messrs. T. Parker, Limited, for the necessary station plant for the purposes of electric traction, according to Mr. Miller's specifications, at £2,353; also with Messrs. R. W. Blackwell & Co. for poles, bracket arms, span, trolley, guard, and other wires, street boxes, &c., necessary for the complete equipment of the overhead trolley line along Stanley Road from the south to the north boundary of the borough, with a branch line along Strand Road to Derby Road; also with Messrs. Callender's Cable Company for the supply and laying of traction feeders at £1,228.

Bridgwater House.—Sixteen tenders were received for the wiring of Bridgwater House state rooms, and that of Messrs. W. J. Fryer & Co., Limited, of Sloane Square, has been accepted.

Glasgow.—We understand that the Corporation Tramway Committee on Tuesday considered tenders for supplying engines for the Glasgow electric tramways. Mr. Parshall, the electrical engineer, strongly recommended acceptance of the tender of Messrs. E. P. Allis & Co., of America, who offered engines for £114,554, and by seven votes to six this tender was accepted. Messrs. Harvey and Williamson, of America, tendered at £160,000 while Messrs. D. Stewart & Co. tendered at £54,800, but offered a lighter engine.

Hapton.—The Parish Council recently invited estimates for lighting the township electrically from September this year to April next year, and the tender of Messrs. Simpson Bros., a local firm, at £118 15s. has been accepted.

Islington.—The Guardians have accepted the tender, £192, from Messrs. Kirk & Randall for telephonic communication at Highgate Hill.

Pembroke (Ireland).—The following is a list of the tenders submitted to the Commissioners for electrical plant, &c.:—

SECTION K.—FOR CONDENSER, AIR PUMP AND FEED HEATER.

Name of firm.		Amount of tender.
Worthington Pumping Engine Company		£535 0 0
Wheeler Condenser Company	(accepted)	556 0 0
Worthington Pumping Engine Company	(alternative)	589 0 0
R. W. Blackwell & Co.		758 9 6
Frederick Nell		854 0 0
John Spencer, Limited		981 6 0
Mirrlees, Watson & Yaryan		1,052 0 0
Klein Engineering Company		1,365 0 0
W. H. Allen, Son & Co.		1,393 0 0
George Wailes & Co.		1,810 0 0
G. S. Derriter		2,192 12 0

SECTION L.—FOR WATER COOLING PLANT.

Korting Bros.		£442 10 0
Wheeler Condenser Company		691 15 0
Klein Engineering Company	(accepted)	707 0 0
Worthington Pumping Engine Company		718 0 0
Isaac Storey & Sons		806 0 0
John Spencer, Limited		850 0 0
Klein Engineering Company (alternative)		877 0 0

Rathmines and Rathgar (Ireland). — The list of tenders for electrical equipment submitted to the Commissioners is as follows:—

SECTION K.—FOR PUBLIC ARC LAMPS AND POSTS.

Name of firm.		Amount of tender.
Veritys, Limited	(accepted)	£3,042 8 6
The Electrical Company, Limited		3,124 3 6
Calvert & Co.		3,291 16 0
Oliver & Co.		3,376 2 0
Johnson & Phillips		3,462 2 0
W. Lucy & Co., Limited		3,463 10 0
The Gilbert Arc Lamp Company, Limited		3,491 10 0
The British Insulated Wire Company, Limited		3,524 6 0
The Gilbert Arc Lamp Company, Limited	(alternative)	3,740 0 0
Crompton & Co., Limited		3,747 17 0
Cotsworth Arc Lamp and Electric Lighting Synd'e, Ltd.		3 761 16 0
Brockie-Pell Arc Lamp, Limited		3,889 19 6
The Walsall Electrical Company, Limited		4,441 18 0

SECTION L.—FOR GENERATING STATION, PIPE WORK, FEED TANK, FEED HEATER, &C.

R. W. Blackwell		£1,789 9 0
John Spencer, Limited	(accepted)	1,997 18 8
George Wailes & Co.		2,134 0 0

SECTION M.—FOR CONDENSER AND AIR PUMP.

The Wheeler Condenser & Engineering Co.	(accepted)	£413 0 0
The Worthington Pumping Engine Company		415 0 0
Frederick Nell		439 0 0
John Spencer, Limited		493 10 0
Mirrlees, Watson & Yaryan Co., Limited		815 0 0
Klein Engineering Company, Limited		895 0 0
W. H. Allen, Son & Co.		1,067 0 0
Bow, McLachlan & Co.		1,250 0 0
George Wailes & Co.		1,250 0 0
G. S. Derriter		1,901 12 0

SECTION N.—FOR WATER COOLING PLANT.

Korting Bros.		£417 10 0
Calvert & Co. (exclusive of pipes)		550 0 0
Wheeler Condenser and Engineering Company		656 15 0
Worthington Pumping Engine Company		725 0 0
Isaac Storey & Sons		781 0 0
John Spencer, Limited		825 0 0
Klein Engineering Company, Limited	(accepted)	847 0 0
Bow, McLachlan & Co.		925 0 0

Sunderland.—The Council last week sealed the contract with Messrs. Dick, Kerr & Co. for permanent way, overhead equipment, and electric cars for the new tramway system at about £126,618. The chairman of the Tramway Committee said that the preparation of the Chester Road route was to be commenced at once, and the permanent way finished by December 31st next, and it would be available for horse trams during the reconstruction of the Hylton Road section. The existing routes were to be commenced as soon after January 1st next as was practicable, and the contractors agreed to complete the Roker, Christ Church, Hylton, and Chester Road sections by June 30th next—ready for electric traction. The remainder, if possible, would be finished by that date, but at the latest by August 31st, 1900, or the contractors would have to pay a penalty of £10 per day. There was also a penalty for the non-delivery of cars. Under the Act the Corporation had five years in which to do the whole of the work, but the committee was anxious to make a smart change from the old to the new systems.

The Town Council has accepted the tender of Messrs. G. and J. Weir, Limited, for two boiler feed pumps, and that of Messrs. Galloway, Limited, for four boilers and economisers. New feeder cables are to be laid for Hendon Road district at £1,550. Three automatic cut-outs for the new steam dynamos are to be obtained at £60, and indicators, meters and house fuses at £300 for stock. An extension of mains is also to be carried out to Roker Avenue and Dock Street Chapel at £587.

NOTES.

Personal.—Mr. Hugh Erat Harrison, B.Sc., principal of the Electrical Standardising, Testing, and Training Institution, has been appointed by the Board of Trade electric inspector to the Corporation of Tunbridge Wells.

A Glasgow evening paper says that ex-Prof. Jamieson has been called out to Cape Town to give expert evidence in a big case between the Cable Company and the Corporation running electric cars, the latter being alleged to affect adversely the working of the delicate telegraphic instruments connected with the cable.

We notice in the *Journal Officiel* of the 11th inst. that the French Government has granted the grade of Chevalier de la Legion d'Honneur to M. Paul Wallerstein, the administrator of the Société Industrielle du Téléphones, under whose personal direction was laid the Brest, Cape Cod, and other cables of the Compagnie Française du Cables Télégraphiques. The distinction conferred on M. Wallerstein will give pleasure to his many English friends.

Mr. O. M. C. Heyl informs us that he has resigned his position as district manager and engineer to the Newcastle-on-Tyne branch of Messrs. English Industrials, Limited, and has joined the engineering staff of the Allgemeine Electricitats Gesellschaft, of Berlin.

Mr. A. H. Roe has been appointed departmental electrical engineer to the Bradford Corporation, in succession to Mr. C. A. L. Prussmann, whom he formerly assisted, and who has gone to Doncaster as Corporation electrical engineer.

Mr. C. A. Midgley has resigned the post of chief assistant electrical engineer at Wakefield, to take up the post of city electrical engineer at York. Mr. H. T. Lee takes Mr. Midgley's place at Wakefield.

Appointments.—Fifty-five applications were received for the post of assistant engineer to the Bournemouth and District Electric Supply Company, and Mr. F. E. Benest, at present with Messrs. Siemens Bros., has been appointed.

Train Lighting—Gas v. Electricity.—In a recent article on "Lighting Railway Carriages by Electricity," the *Engineer* said that the total weight of the electric plant is less than would be required for a gas lighting system affording the equivalent amount of light. This has drawn from Pintsch's Patent Lighting Company a correction, stating that the weight of the electric light apparatus is rather more than double the weight of the gas lighting apparatus, the latter giving a superior light. The editor of our contemporary has wisely asked the writer and also Messrs. Stone & Co., of Deptford, the owners of the Gill train electric lighting system, to give actual weights of their respective systems. This information, if forthcoming, should be interesting.

The Opposition to the Pacific Cable Scheme.—At the present moment, when all who have the best interests of Great Britain and her dependencies at heart, and who are not inspired by motives of self-interest, are very anxious that the Pacific cable scheme should enter the sphere of active operations, it is worth while noting the tactics of the opposition group of cable companies. The only reply they received to their protest was a snub, if we may put it curtly, from the lips of Government Ministers. Perhaps this was responsible for raising their ire, for no stone has been allowed to gather moss which by rolling would postpone still further the great scheme. Now that there seems to be some prospect of a settlement, the tactician has been secretly at work upon further details in the opposition programme. To fill certain works with orders to occupy them for a long time ahead so that they would be unable to carry out the Pacific contract, to purchase gutta-percha in large quantities, thereby restricting the market and stiffening the price, these have been some of the the methods adopted to serve the desired end. The mere knowledge of these facts should be sufficient to place the Government officials upon their guard. We will not devote too much space to discussing the legitimacy of the procedure, but we would add that others also have had a watchful eye upon submarine cable material, and there are other works, who, we believe, are well able to fulfil the Pacific contract with satisfaction and expedition. The activity in submarine cable work just now is noteworthy. We believe it is a fact that about 14,000 miles of such cable are either on order or contracts are ready to be let, and the greater part of it may, as hinted above, be gathered into one net. Our representative called on one of the manufacturers for confirmation of the above rumour, which had reached us through other channels, and was informed that although the rumour is correct, generally speaking, some of the particulars are erroneous. The manufacturer hazarded the opinion that a well-known Company would probably use its undoubted influence in the cable ring, and would fan the forest fire which is apparently causing a stampede among the managers of the Globe Telegraph and Trust Company and its satellites. As a journal representing trade interests, we approve of reserve funds, hitherto invested in Government stocks and railway debentures, being realised and employed to promote fresh work, but such action should be taken deliberately and after mature consideration, and should not convey the impression that the copper dam has burst on the appearance of the Pacific cable banshee.

A Fair Hearing Wanted for the Trolley.—The current issue of the *Railway World* contains a timely note regarding the objection frequently raised of late by opponents of the overhead trolley system that it is not giving satisfaction in America. We reproduce the following on the point, which may be of interest both to Prof. Kennedy and the London County Council :—

Rumours of dissatisfaction with the trolley system in America are very greatly exaggerated. Complaints are occasionally made, but these are generally due to particularly unsightly street work, such as no one would propose to repeat in this country. Take the United States as a whole, and leaving out of the account the cities of New York, Chicago, and Washington, it may be said that the trolley system is universally approved by both the public and the tramway companies. Of the 16,000 miles of electric railways, all but a very small proportion are trolley lines. Visitors to America who have not penetrated further than New York, may return and write to the newspapers that the trolley lines are being replaced by the conduit system, but the fact is that no trolley lines in America have as yet been removed, nor are there any projects for conversion. In New York and Washington, and in some streets in Chicago, the overhead wire has never been admitted, largely because older forms of mechanical traction rendered less necessary the immediate adoption of the trolley. Elsewhere the trolley has met with approval, and it has done excellent service. History will repeat itself here as fast as new lines are opened, and corporations that have decided to instal the trolley system have no occasion to reconsider the question. The Manchester Council, which has been urged to send a delegation to America to investigate with a view to reconsideration of the determination to adopt the overhead wire, has made no mistake in declining to accept the suggestion. Its advisers perfectly understand the situation abroad, and at the present stage they recognise that, all things considered, the trolley system will most completely meet the requirements of the city for cheap and comfortable transport.

Obituary.—It is with great regret that we record the death of Sir Edward Frankland, who was celebrated for his great work in the field of organic chemistry. He was also an eminent authority on water analysis, particularly in connection with the London water supply. He was the Government water analyst. For many years he held the post of Professor at the Royal College of Chemistry (School of Mines), retiring therefrom in 1885. He had previously acted as Professor of Chemistry at the Royal Institution, at St. Bartholomew's Hospital, and at Owens College, Manchester. In 1865 the Royal Society awarded him the Royal Medal for his researches into the new series of organic bodies containing metals. His "System of Notation," published in the *Journal of the Chemical Society*, is said to have cleared up a great many points in organic chemistry. His "Lecture Notes for Chemical Students," published in 1876, have had a large circulation, while he also published "Experimental Researches in Pure, Applied, and Physical Chemistry," and several hand-books. He has occupied the presidential chair of the Chemical Society and the Institute of Chemistry, and he was also a member of numerous English and foreign scientific societies. Sir Edward was born in 1825, so was 74 years of age. He will be well remembered in electrical circles as a member of the Committee of the Electro-Harmonic Society, at whose concerts he was frequently present in the capacity of chairman.

It also falls to our lot this week to chronicle the death of another very eminent worker in the school of chemistry. Prof. R. W. Bunsen, F.R.S., died at Heidelberg, on Wednesday morning, in his eighty-ninth year. So far back as 1836 the deceased professor succeeded Wöhler as professor of chemistry in the Cassel Polytechnic School, and some 16 years later, in 1852, he was appointed to the chair of experimental chemistry at Heidelberg. This appointment he held until 1889, when he resigned. Meanwhile honours were conferred upon him from all directions for his remarkable investigations and discoveries, but it seems from what we read in the *Times* that beyond all the orders and decorations of monarchs he valued the foreign fellowship of the Royal Society, to which he was elected in the year 1858, and the recognition of his work by numerous other scientific societies. The Royal Society in 1860 awarded him the Copley medal, and in 1877 he and Kirchhoff were jointly made the first recipients of the Davy medal. The Bunsen gas burner has made his name familiar in every household, while the Bunsen voltaic battery is known to every electrical student. From the list of his very numerous investigations we may select for brief mention the chemistry of blast furnace gases, actinometry, and the chemical action of light, but his greatest work is considered to be that undertaken with his colleague Kirchhoff on spectrum analysis. The work of these two professors placed analysis by spectrum observation on a sound and firm experimental basis. At the time of his death Bunsen was spending his last days in well-earned retirement at Heidelberg.

Standard Electric Wiring Rules.—Mr. W. G. McMillan, the secretary of the Institution of Electrical Engineers, is sending out the following circular on this very important subject. The recent papers and discussions at the Institution on the desirability for securing uniformity, or something approaching thereto, will be well within the minds of our readers:—

> You are no doubt aware that members of our profession who wire premises for the supply of electrical energy have for some time past been complaining that they are harassed by the multiplicity of existing rules. It is generally admitted that the rules, framed by a committee of experts representative of the special interests involved, and published by this Institution, have been accepted by a large number of central station, municipal, and consulting engineers, inspectors for fire insurance offices, and others.
>
> The council of this Institution has appointed a committee to inquire into the reasons, if there be any, which prevent the Institution rules being accepted by everyone as the standard. The committee feel that it is very probable that most of the authorities who are using other rules might be induced to accept those of the Institution if these latter were modified in some particulars. As a first step, therefore, towards the standardising of rules, the committee are anxious to receive any reasonable suggestions that may be offered with the above object. I should be glad if you would kindly let me know whether you would, if called upon, be willing to assist the committee with your advice and criticisms on the existing rules, and, if so, I am directed to inform you that the committee will prepare and forward to you a paper of questions, to which they will ask you to be good enough to reply."

Contracts for Steel Work.—Following the explanation of the Atbara bridge contract comes the announcement in the daily press of a large Japanese steel contract placed with an American house, in fact with the contractors for the Atbara work, viz, The Pencoyd Iron Works of Philadelphia. The contract is for the supply of from 8,000 to 10,000 tons of steel for bridges within a year for the Japanese government. The value of the order is $750,000. We should think it is pretty certain that here again the time element influenced the placing of the contract, and it is interesting in this connection to draw attention to a statement made last week at the meeting of the British Westinghouse Company. The contract for the iron and steel work for the new works to be erected at Manchester is to be executed by the Carnegie Company, of Pittsburg, within four months. It seems that the present state of English iron and steel works would not allow them even to look at such urgent business.

Record Trip.—*The American Electrician* says that the longest trip of storage battery automobiles ever reported is that of Comte de Chasseloup Loubet, who drove, July 2nd, from Paris to Rouen without recharging, the distance being some 85 miles, and the time 7 hours and 15 minutes. After recharging, the return trip was made the same night in practically the same time. The vehicle was of the Jeantaud make.

Appointments Vacant.—The D. P. Battery Company wants a works' manager at the Lumford Mills, Derbyshire. See "Official Notices" this week.

The Edinburgh Corporation wants two assistant engineers for its electricity supply stations at £100 a year. See "Official Notices" this week.

A telegraph foreman is required for the Telegraph Department, Gold Coast. See "Official Notices" for particulars.

The Government of Jamaica requires an experienced electrician to act as inspecting engineer for all matters connected with electricity, at £500 per annum. See "Official Notices" this week.

Electric Motor Carriages, ad lib.—They are talking of very big things in the automobile way across the Atlantic. We read that President Rice, of the Electric Storage Battery Company, says that orders have recently been placed for 4,200 vehicles at an aggregate selling price of some $8,000,000. They consist of about 2,000 pleasure vehicles, 2,000 hansoms and broughams, and 200 delivery waggons. It is anticipated that they will not all be sold, but the greater part will be operated by the local sub-companies of the Columbia and Electric Vehicle Company. By the way, we presume that in keeping with our namesake's ruling, this company should reconstitute itself as the Columbia and Automobile Company.

The British Association.—Canterbury has appointed an influential executive committee to carry through arrangements for giving the members of the British Association and the French Academy of Sciences a fitting reception on September 21st. The visitors are expected to number about 1,500.

Apparent Dark Lightning Flashes.—Lord Kelvin writes from Aix-les-Bains, August 7th, to *Nature*:—

> Last night, during a thunderstorm of rare severity, in which brilliant flashes—single, double, triple, or quadruple—followed one another at intervals often of not more than a few seconds of time, I was surprised to see, with great vividness, on a suddenly illuminated sky, two nearly vertical lines of darkness, each of the ordinary jagged appearance of a bright flash of lightning. I remembered to have seen two real flashes of just the same shapes and relative positions, and I concluded that the black flashes were due to their residual influence on the retina. I turned my eyes quickly from the dark sky outside to an illuminated wall inside the house, and I again saw the same double dark "flash," which verified my conclusion in an interesting manner. The fatigued part of the eye failed to perceive the sudden brightness of the sky in the one case and of the wall in the other.

Swiss Visit of the Institution.—The secretary asks us to remind those who, being eligible, wish to participate in this visit, and who have not already applied for tickets, that applications should be submitted to him before *Thursday*, the 24*th inst.*

Speed Tests on High Speed Electric Railway.—The *Street Railway Journal* publishes some speed tests made upon the Cleveland-Lorain Railway, which are of interest as being made upon a high speed road that has practically no grades and few curves. The cars tested have four G.E. 57 motors geared 1 : 5·7, with 33-inch wheels and Brill trucks. The cars weigh 24 tons (apparently 2,000 lb. tons). On a grade of 1—500, the speed per hour taken at the end of six periods of 10 seconds each is given, west bound, 9·7, 26 6, 34·8, 39·6, 40·8, 47·2. By the end of 60 seconds the car had run 2,913 feet, at an average of a little over 33 miles per hour. East bound and probably up grade the speed attained was 43·1 miles per hour in a distance of 2,520 feet, but the average speed between the fortieth and fiftieth second was 47·4 miles per hour. Similar differences appear with other cars, but practically the tests show that between 40 and 50 seconds after starting, a speed of 40 miles can be easily exceeded against a wind of 10 to 15 miles' velocity. On a run of 60 seconds of a 23-ton car in which a distance of 2,802 feet was covered, the following readings will be of interest for each period of 10 seconds on a down grade of 1 in 500 :—

Seconds.	Amperes.	Volts.	Feet run.	Total distance.
10	485	500	149	149
20	350	520	144	493
30	275	550	483	976
40	225	570	559	1,535
50	195	575	630	2,165
60	180	580	637	2,802

On a nearly level and straight track, with moderate wind of 6 miles per hour, the traction in both directions was 31·75 and 32·53 lbs. per ton at speeds of 40 to 49 miles per hour, and 39 to 51 miles. These are the average readings at two points on the track under favourable conditions. Other tests show tractive forces of 30·8, 34·1, and 32·6 lbs per ton, at similar speeds up to 51 miles.

Boilermakers Busy.—"Remarkable activity" is the account of the boilermaking industry during the past quarter. Mr. Knight, the general secretary of the United Society of Boilermakers and Iron and Steel Shipbuilders, reports that the demand for men has been greater than the supply. The demand fluctuates very considerably. This is practically unavoidable, but Mr. Knight adds, if it were possible to regulate the demand so as to ensure a steady and continuous employment, it would be an unqualified blessing both to employers and to workmen.

The Progress of the Manchester Electricity Works.—For the purpose of the Iron and Steel Institute visit to the Corporation electricity works this week, Mr. C. H. Wordingham, the city electrical engineer, drew up a pamphlet giving particulars of the generating and distributing plant at the central station, Dickinson Street, and the various sub-stations. The works were started in 1893 with a capacity of 1,320 KW., with plenty of floor space and chimney accommodation to allow for large extensions. Vertical compound condensing engines, 100 H.P. and 400 H.P., driving by means of link belts shunt wound continuous current bipolar dynamo machines, were installed, and the employment of jockey pulleys riding on the top slack side of the belts for greatly shortening the length of the drive is said to have been amply justified by experience, the loss of power with this method of driving compared with an ordinary belt being inappreciable. Lancashire boilers with Galloway tubes were installed, and coking mechanical stokers. The first extension was carried out in 1894-5, and consisted of two more 400-H.P. engines of the same design, with corresponding dynamos. The second extension took place in 1895-6, when the buildings had to be enlarged, and at this stage Mr. Wordingham was appointed consulting as well as resident engineer. The definite plan laid down when the original works were designed for extending plant has been strictly conformed to in subsequent developments and the same type of plant retained. Experience has shown that this course was well advised, but the uniformity has been broken by the erection of two horizontal engines of the same power as the vertical engines, driving similar dynamo machines by means of ropes instead of belts, this being done for purposes of comparison with the vertical sets, but the original design has been fully proved to be the better. The 1895-6 extension added six vertical sets, 400 H.P., and two horizontal, an extension to the boiler house, and five more Lancashire boilers. In 1897-9 the third extension was taken in hand. The large increase in size of the works had rendered the small units of plant originally put down practically useless, and the six small sets were removed for replacement by two large engines of 2,500 H.P. each for direct driving. On the space formerly occupied by generators developing 600 H.P., there are now fixed generators developing 5,000 H.P. The whole of the balancing on the five-wire system is now done by means of motor generators instead of dynamo machines. Six more Lancashire and four Babcock boilers were installed. It should be added that this last extension is not yet quite complete, the second large generator being still in course of erection. Mr. Wordingham follows with a description of the station as it now exists, also the sub-stations, mains, &c. The electric street lighting at Manchester is not a large item, there being only 28 open type arc lamps and one enclosed in use. All the lamps are fed from the ordinary distributing mains. The unenclosed arcs take 10 amperes and the enclosed 5 amperes. There were at June, 1899, 2,703 consumers with 261,988 8-C.P. lamps (or equivalent) connected (this comprising 379 motors aggregating 1,320 H.P.). The total demand, if all consuming devices were working at once, would be 8,430 KW. For the year ended March 31st, 1899, 4,773,247 units were sold, the total maximum supply demanded being 4,246 KW. The total costs per unit sold were 1·53d., the works' cost being 1·11d. Large extensions are now in progress for supplying outside districts, a scheme which has been often referred to in our columns, and for traction purposes. At a station to be erected in Bloom Street, there will be four direct coupled sets of 1,800 KW. each, to give current either for lighting at 400 to 440 volts, or for traction at 500 volts. These generators are already on order. This plant will deal with an area having a radius of about half a mile from the station. The rest of the area of supply will be dealt with by means of an entirely new generating station at Stuart Street, $2\frac{3}{4}$ miles from Dickinson Street. Here there will be fixed generators producing three-phase current at a pressure of 6,500 volts, which will be transmitted to a number of sub-stations situated at various points in the district of supply. At these sub-stations the high pressure three-phase current will be converted into low pressure continuous for all purposes, viz., lighting and traction on a three-wire network with 200 volts on lamps, 400 for motors, and traction at 500 volts.

A Method for Determining the Resistance of Electrolytes.—This new method has recently been worked out by Parker C. McIlhiney (*vide Journal of the American Chemical Society*, Vol. 20, pages 206—209), and whilst not so accurate as that of Kohlrausch, is of advantage for making many readings in a short space of time. It consists in determining by a galvanometer, preferably a D'Arsonval, the potential difference between the ends of a known resistance placed in series with the resistance to be determined. The current is supplied by a gravity battery, and before passing through the electrolyte, it is transformed into an alternating current by means of a rotary pole changer, but the current passing through the known resistance is direct. When a current passes through two resistances in series, the fall of potential in each of them is proportional to its resistance.

Chemical Effects of X Rays.—When photographic plates that have been exposed to the action of X rays are afterwards exposed to light, the image undergoes reversal in the same way as if both exposures had been made to light, and the precise character of the phenomena depends on the relative magnitudes of the exposures. Plates exposed for some time to X rays show increased sensitiveness to the less refrangible rays. An interesting communication on this subject was recently made by P. Villard in the *Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences*, Paris, Vol. 128, pages 237—239.

The Solution of Platinum and Gold in Electrolytes.—This subject was studied by Max Margueles last year, and a paper appeared by him in *Poggendorff's Annalen der Physik und Chemie*, (II.), Vol. 65, pages 629—634, in which the results of his researches were given. In his earlier experiments, it may be remembered, an electro-magnet with armature served as contact breaker to the current from two Daniell cells, and between the terminals of the coil of the magnet an electrolytic cell with gold or platinum electrodes was introduced. With this arrangement the metal can be dissolved in hydrochloric, nitric, or sulphuric acid, or in potassium or sodium hydroxide. The metals always dissolve from the electrode, which is the anode to the battery current. The solution is, however, in some way assisted by the current from the magnet, as neither a constant nor intermittent current from the battery alone is capable of effecting solution. In the same journal Margueles makes some additions to his former statements with reference to the dissolving of platinum and gold in electrolytes. The dissolution of platinum takes place only at the anode when the cation of the electrolyte is hydrogen; in salt solutions the platinum is attacked simultaneously at both anode and cathode. Platinum not only dissolves in the electrolytes previously named, but also in phosphoric, formic, and acetic acids; oxalic acid is, however, without effect.

Determination of Polarization.—In an electrolytic cell of resistance, R, with insoluble anode, through which current, C, is passing with E.M.F. = E, we have $E = p + CR$, where p is the polarization. If a thin sheet of metal be interposed between the electrodes so as to divide the cell completely, without sensibly affecting its resistance, and the current be maintained unchanged, we have $E' = 2p + CR$, or $p = E' - E$. In putting the method into practice, the main difficulty is encountered in arranging the cell so that the third electrode may be put in or taken out easily, and in such a way that the current shall pass through it, and not round it. A rectangular ebonite cell is provided with platinum electrodes fitting into grooves in the walls 60 mm. apart. Between these a third groove, 8 mm. deep and 0·25 mm. wide, receives the third electrode. This depth is sufficient to prevent undue leakage round the electrode with moderate conductivities and current densities. A greater depth would be better. About half an hour elapses before the polarization becomes constant. The following are some of the results obtained:—

Copper Sulphate, 16 per cent., at 14·7—14·95°.

Current density	0·03	0·06	0·12	0·2	0·3 amp. sq. dcm.
Polarization ...	1·591	1·628	1·668	1·695	1·717 volts.

Silver Nitrate, about Normal, at 15—15·5°

Current density	0·015	0·03	0·06	0·12	0·2	0·4 amp. sq. dcm.
Polarization ...	0·888	0·897	0·903	0·908	0·926	0·935 volt.

The above is an abstract of a paper by Karl Heim in the *Zeitschrift für Elektrochemie*, Vol. IV., page 527.

NEW COMPANIES REGISTERED.

Electric Battery Case and Fittings Syndicate, Limited (63,268).—This company registered on August 10th, with a capital of £12,000 in £1 shares, to carry on the business of manufacturers of and dealers in electric battery cases, cells and fittings of every description, and to adopt an agreement with J. H. W. Stringfellow. The first subscribers (each with one share), are:—William Morgan, 6, Great Winchester Street, E.C., accountant; John W. Savage, 10, Hafer Road, New Wandsorth, S.W., chemist; Thomas Black, 103 Grosvenor Road, Highbury, N., gentleman; William Burley, 99, Shardeloes Road, New Cross S.E., engineer; William Pickering, 6, Garway Road, Bayswater, secretary; Edmund White, 2, Denby Road, Ealing, W., chemist; and Mrs. Jane H. Braithwaite, 390, Uxbridge Road, W. The number of directors is not to be less than three nor more than seven; the subscribers are to appoint the first; qualification £250; remuneration as fixed by the company.

Brazilian Street Railway Company, Limited (63,241).—This company was registered on August 5th, with a capital of £120,000 in £1 shares, to acquire the business hitherto carried on by the Brazilian Street Railway Company, Limited (incorporated in 1868) to adopt an agreement with the said old company and its liquidators, and to acquire, construct, equip, and work railways, tramways, buildings, electric traction and lighting works, &c., in Brazil. The first subscribers (each with one share) are:—J. S. B. Hawkins, Hagenhoe Park, Welwyn, banker; A. G. Kendall, 148, Leadenhall Street, E.C., merchant; W. Martineau, 3, Beaumont Villas, Hornsey Rise, N., civil engineer; F. R. Bluett, Egerton House, Beckenham, accountant; J. Wilkinson, 38, Nicholas Lane, E.C., solicitor; H. Bluett, Egerton House, Beckenham, Kent, accountant; and J. W. Walker, 2, Abercorn Terrace, Upper Holloway, N., accountant. The number of directors is not to be less than three, nor more than seven; the first are William B. Hawkins, Arthur S. Kendall, William Martineau, Samuel J. Wilde, and T. Comber; qualification, 500 shares; remuneration, £400 per annum, divisible.

Kalgoorlie Electric Power and Lighting Corporation, Limited (63,248).—This company was registered on August 8th, with a capital of £225,000 in £1 shares (200,000 preference and 25,000 deferred), to enter into an agreement, dated August 3rd, with the Kalgoorlie Power Syndicate, Limited, to acquire, own, and work any land, water rights, electrical and other works, &c., and to establish and maintain a system of generating and supplying electricity for mining purposes, and otherwise. The first subscribers (each with one share) are:—J. T. Thompson, 116, Nevill Road, Stoke Newington, N., gentleman; C. E. Mozley, 257, Winchester House, E.C., secretary; S. F. Wall, Rock Villa, Wallington, Surrey, clerk; C. N. L. Shaw, 1, Elm Villas, Derby Road, South Woodford, clerk; W. Owston, 134, Dornton Road, Balham, S.W., clerk; H. D. Kerr, 5, Buaburgh Terrace, N.W., secretary; and M. E. Williams, Winchester House, E.C., solicitor. The number of directors is not to be less than three nor more than seven; the subscribers are to appoint the first; qualification, £250; remuneration, £250 each per annum (an extra £100 for the chairman), and a share in the profits.

Sun Electrical Company, Limited.—This company was registered on August 9th, with a capital of £50,000 in £1 shares (20,000 preference) to acquire and take over as going concerns any electrical businesses, and to carry on the business of manufacturers of and dealers in electrical accessories and instruments, wires, cable and lines of all kinds; electricians, electrical and mechanical engineers, suppliers of electricity for the purposes of light, heat, motive power and otherwise; bicycle, tricycle, velocipedes and motor car manufacturers; cycle accessory and appliance manufacturers, &c. The first subscribers (each with one share) are:—F. H. Minn, 77, Grange Park Road, Leyton, electrician; F. J. Collis, 61, New Kings Road, S.W., electrician; G. Payne, 53, Goldhurst Terrace, South Hampstead, N.W., gentleman; R. T. Smith, 61, Carey Street, W.C., solicitor; N. H. Boyne, 61, Carey Street, W.C., solicitor; J. W. Reacher, 4, Queen Victoria Street, E.C., stockbroker; F. O. Smith, Hilldene, Harrow, solicitor. The number of directors is not to be less than three nor more than five; the first are F. H. Minn (managing director), R. T. Smith (chairman), and G. Payne; qualification, £200; remuneration as fixed by the company.

Woking Laundry Company, Limited.—This company was registered on August 2nd, with a capital of £2,500 in £1 shares, to acquire and carry on the business of the Woking Sanitary Electric Laundry Company, Limited. The first subscribers (each with one share) are:—C. A. Rollason, 6, Fairlight Avenue, Harlesden, N.W., engineer; G. R. Rollason, 26, Greenhill Road, Harlesden, N.W., engineer; W. G. Parker, Windlesham Road, Harlesden, N.W., gardener; E. T. Pimms, 34, High Street, Harlesden, licensed victualler; E. Mann, Palace Chambers, Westminster, S.W., engineer; W. H. Fletcher, 123, Abbey Road, N.W.; and W. F. Fearn, 3, Delahay Street, Westminster, solicitor. The number of directors is not to be less than three nor more than seven; the first are E. Mann, W. H. Fletcher, and C. A. Rollason; qualification, £50; remuneration as fixed by the company.

River Plate Construction Company, Limited (63,271).—This company was registered on August 10th, with a capital of £120,060 in 1,200 £100 ordinary shares, and 1,200 1s. deferred shares, to carry on the business of electrical engineers and suppliers of electricity for the purposes of light and power, and to establish and maintain electric lighting works, signalling, telegraphic, telephonic, and other systems, tramways, railways, &c. The first subscribers (each with 10 deferred shares) are:—C. Bright, 14, Copthall Avenue, E.C., engineer; A. F. Farish, 57½, Old Broad Street, E.C., solicitor; A. G. Lewis, 47, Park Road, Forest Hill, clerk; E. E. Ford, 12, Kylemore Road, N.W., gentleman; T. F. Stevens, 37, Sandown Road, Woodside, S.E., gentleman; G. A. Eggleton, 10, Cheriton Square, Upper Tooting, S.W., secretary; W. A. Hunter, 27, Trossacks Road, Dulwich, S.E., clerk; J. W. Ward, 14, Marney Road, S.W., gentleman; T. C. Richards, 57½, Old Broad Street, E.C., clerk; and W. S. Wild, 33, London Road, Clapton, N.E., gentleman. The number of directors is not to be less than three nor more than seven; the subscribers are to appoint the first; qualification, £10; remuneration, £100 each per annum.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Thomas Parker, Limited (40,973).—This company's annual return was filed on July 20th, the entire capital of £75,000 in £10 shares being taken up; 1,750 shares are considered as fully paid and £10 has been called up on each of the remaining 5,750, resulting in the receipt of £57,500.

Oldham, Ashton and Hyde Electric Tramway Company, Limited (55,318).—This company's annual return was filed on July 28th, when the entire capital of £30,000 in 4,000 ordinary and 4,000 preference shares of £10 each was taken up and paid in full.

CITY NOTES.

Liverpool Overhead Railway Company.

The half-yearly meeting was held on Tuesday, at the Law Association Rooms, Cook Street, Liverpool, Sir Wm. Forwood, chairman of company, presiding.

The Chairman, in moving the adoption of the report, said it had been the good fortune of the directors to meet the shareholders each half-year with an account showing expanding traffics and increased passenger receipts. He therefore regretted they could not on this occasion render to them a similar gratifying statement. It was true that they showed a small increase of 2,338 in the number of passengers carried as compared with the corresponding half of last year, but this was due to the late service of trains, which, by permission of the Dock Board, they now ran to Seaforth, which had given them a traffic of over 100,000, and also to an increase of 286,486 in the number of workmen carried, owing to the extension of time they had given to working men's return tickets; but their loss of revenue on the southern section of the line, between the Pierhead and the Dingle, had been very little less than £2,000 in the half-year. This loss was due entirely to the competition of the Corporation electrical tramways, which were now carrying passengers to the Dingle, a distance of 2½ miles, for 1d. Glasgow, which had a model system of tramways, for an equal distance charged 2d. and 2½d. It was admitted by the chairman of the Tramways Committee that they made a loss last half-year of £7,000 on the entire service, and, so far as he had been able to analyse their accounts, the loss on the Dingle line had exceeded this amount. The public had an undoubted right to enjoy the lowest possible fare at which the tramways could be worked, but the City Council had no right to run their tramways at a loss, to the injury of private enterprise. It was not merely making the general community pay for the benefit of the few, but introducing a principle most disastrous to the prosperity of the country. A continuation of the present tramway policy would mean the levying of a tramway rate to pay the annual deficit, and the Overhead Railway Company, as one of the largest ratepayers in the City, would have to contribute to this rate. He knew that they would agree with him that this was scarcely a fair state of things. It was not ordinary business competition, and, if it occurred in other walks of life, Parliament would step in to stop it. Certainly the Overhead Railway was entitled to the special consideration of the City Council. It was constructed solely to facilitate and cheapen the service of their docks, and to enable Liverpool to maintain her commercial position, and it had, undoubtedly, largely contributed to this result. Liverpool owed its very existence to its commerce, and one would have thought the first care of the City Council would be to conserve the interests of an undertaking admittedly doing a great public service for the commerce of the port. On the contrary, they saw not only public money being used to their injury, but, to compete with them, a speed was maintained through the public streets frequently much in excess of the Board of Trade regulations, which would not be possible unless the police were employed to safeguard the traffic. Their railway was further threatened by a proposal of the City Council to obtain running powers over their Waterloo and Crosby tramways and by the construction of an electric tramway along the line of docks, running parallel with the overhead railway. He could not think that either of these proposals were likely to be seriously considered. To construct a line of electrical tramways along the line of docks would simply be to duplicate so much capital. It was admitted that the Overhead Railway gives an excellent service, both in speed and in the frequency and regularity of the trains, and it did that without any interference with the street traffic. He had thought it well to bring these circumstances before the shareholders, but he was sure they need not feel any alarm. He thought they were now encountering the worst of the tramway competition. Matters had been very much rushed, but he saw indications that wiser counsels would now prevail on the Tramways Committee, and that they would try to get back to a sound business basis. He could assure them that the directors of the company had pursued a watching and waiting policy. They had not attempted to meet the competition by reducing their fares. They had anticipated the difficulties of the Tramways Committee, and felt sure that when they had some experience of working with electricity, they would find out—as the Overhead Railway Company had found out—that the cost of working during the first year was not a basis upon which they could calculate in future, and that it was not possible to permanently have a penny stage of 2½ miles, except at a serious loss. Referring to the accounts, he said the gross receipts for the half-year had been £36,492, against £37,220 in the same half of last year, or a decrease of £728. The expenditure had been £24,924, as against £23,326, showing an increase of £1,548. This increase had been accounted for in a larger payment for coal of £691, owing to the flooding of the mine with which they held their contract. The expenditure in materials had increased by £257, principally due to the renewal of their commutators, and the increased price of copper. Then during the past two years they had spent £2,300 in the removal of their storage batteries. They had also during the half-year to re-wind a great many of their motors; but the result of all this extra outlay, he hoped, would enable them to work more economically during the present half-year. It had always been their policy to maintain the line in a thoroughly efficient condition, and in the speed, comfort, and punctuality of their service to maintain the good opinion they had earned. Their earnings per passenger had fallen from 1·98 to 1·95, owing to the decrease of first-class traffic from the Dingle and the increase of workmen's return tickets. Of the future he would not prophesy, but he thought they had seen the worst of the tramway competition. Municipal trading was a dangerous and uncertain factor, and had not been a success in this country. The directors would carefully watch developments, and the shareholders might depend that their interests would be carefully safeguarded in every way. He was pleased to add that the line had lost none of its attractiveness to the holiday people, as the traffic last Bank Holiday was the largest on record.

Mr. R. Hobson seconded, and the motion was carried.

It was further resolved that a dividend at the rate of 5 per cent. per annum be paid on the preference shares for the half-year, and a dividend at the rate of 2½ per cent. per annum be paid on the ordinary shares, leaving a balance of £4,320 to be carried forward.

The Chairman, in acknowledging a vote of thanks to the directors, said it was very gratifying to receive such a vote, seeing the shareholders had got a reduced dividend. This showed that their efforts were appreciated. He still looked forward with confidence to the future prosperity of the Overhead Railway Company.

Waterloo and City Railway Company.

Mr. Wyndham S. Portal (chairman) presided on Thursday last week over the half-yearly meeting of the above company, and in moving the adoption of the report said the figures had been fully explained in previous half-years, and did not require on this occasion any detailed examination. On the last occasion he congratulated them on the completion and opening of the line, and now he had to congratulate them on the first complete half-year. Capital account showed total expenditure to the present time of £566,134, of which £16,678 had been expended during the past half-year. It was estimated that a further sum of £56,000 would be required, which was amply provided for by the company's available powers amounting to £145,531. The authorised capital is £720,000, and of that, £540,000 had been raised by the issue of ordinary stock, and £26,000 by debenture stock, making a total amount raised of £566,000, or an increase of £5,000 since the preceding half-year ending December, 1898. As regarded the revenue account, during the past half-year the gross receipts, after deducting Government duty, had amounted to £13,114. £13,093 was received in fares and £300 in rents. Government duty was £278, leaving the sum of £13,114, from which the South-Western Railway Company had retained for working expenses, £4,690, or, £1,950 less than the actual working expenses. The balance was £8,424, which was payable by the South-Western Railway Company, under the agreement of March, 1894, to enable the Waterloo and City Company to pay a dividend at the rate of 3 per cent. per annum on the ordinary and borrowed capital. To this £8,424 they had to add £10 10s. for transfer fees, which made £8,434 odd, and they had to deduct £406 for general charges, and £5 18s. for law and Parliamentary expenses, which left £8,021 to be carried to the next account. The net revenue account commenced with £290 balance brought forward from last half-year, then they had the figure of £8,021 just mentioned, to which they added £190 for bankers and general interest and an item of £625 10s. described as "rent charge," and this made a total on the credit side of that account of £9,155. Out of that they had had to provide £324 as interest on debenture stock, and £458 rent charge payable to the South-Western Railway Company, in respect of the easement at Waterloo Station and that left them with £8,372 available for dividend, and they proposed to pay a dividend at the rate of 3 per cent. per annum on the ordinary capital, and carry over £272 to the next half-year. They would notice the auditor had added at the end, the words, "There is a contingent liability to repay to the South-Western Railway Company, the deficiency in respect of net revenue." This referred to £1,950 which he had mentioned, and to a sum of £1,869 which was similarly provided by the South-Western Company in respect to the working of the preceding half-year. These two amounts together made £3,819, and the agreement of March, 1894, provided that if in any subsequent half-years the difference between receipts and working expenses was sufficient to pay a dividend of more than 3 per cent. the South-Western Company should be at liberty to recoup themselves the amounts which they had provided in previous half-years. This was the contingent liability to which the auditors referred. The number of passengers carried during the past half-year was 1,715,825, or a daily average of 11,142, and the number of season ticket holders at June 30th last was 747, which was estimated to be equal to 194,220 single journeys, or a daily average of 1,261. This made the total daily average number of journeys 12,403. As the railway was only in its infancy they were unable to make a comparison with any previous period, and they would, of course, remember that the City station was still unfinished, inasmuch as the subways and approaches to be constructed by the Central London Railway Company had not yet been completed. Two days ago he received a report of the engineers, Mr. Galbraith and Prof. Kennedy, which he thought they would like him to read, as follows:—"The works of the railway have now been tested with 12 months' continuous running and are all in good order and repair. A little trouble was at one time experienced from leakage of water in the short brick tunnel at Waterloo, but it has much diminished, and the pumps which were provided to meet this contingency were found to be amply sufficient. The iron tunnels within which the railway and City station were constructed are quite watertight and are perfectly sound. The Central London Company's subways at the Mansion House are fast approaching completion, and it is hoped that three additional communications between the streets and the subways will be ready for use in October, namely, (*a*) in Mansion House Place, (*b*) at the Union Bank, Princes Street, and (*c*) at the junction of Lombard Street with the Poultry. At the same time the two staircases at the City station will be shortened and improved. Since the opening of the railway the line has been continually worked with the electrical plant provided in the generating station at Waterloo. The electrical difficulties which occurred in the

earlier working of the line have, as was to be expected, yielded to time and experience, and all the electrical apparatus appears now to work regularly, steadily, and without difficulty. The trains have for months past been running to a time table at six minutes interval during the busiest part of the day. Further rolling stock has been ordered by the London and South-Western Company, and when this arrives it is intended that the trains shall be still more frequent than they are at present."

Lieut.-Col. the Hon. H. W. Campbell seconded the motion and it was carried.

National Telephone Company.

Mr. J. S. Forbes (chairman) presided on Thursday last week over the twenty-fourth ordinary general meeting of the shareholders of the National Telephone Company held at the Cannon Street Hotel, and in moving the adoption of the report said the accounts were very similar to those of previous years, the only essential alteration being in the figures. Under all the circumstances, the directors considered the figures eminently satisfactory. There had been an increase in the income for the half-year of £63,000, which had been attended with an increase in the working expenses, but still they were left with an increased profit of £24,844, which was no inconsiderable sum. Comparing the figures with the corresponding half of 1898, they would see that the Post Office royalties had increased by a very large sum, and amounted to £58,859—an increase of £9,186. The net income had increased by £54,000, and the working expenses by £29,000. The working expenses had been reduced from 61·94 per cent. to 61·15 per cent., which was a tangible gain. The debenture and other interest had increased by £7,623, but the preference and ordinary dividends were practically the same. They proposed to carry to reserve £60,000 as against £50,000, and to carry forward £5,213 against £548. A most interesting and satisfactory feature was the large sum for rentals carried forward for unexpired terms. They had already received the enormous sum of £651,000 in respect of services to be rendered by the company after the expiration of the term they were dealing with, and that was an increase of £56,000. In fact, so far as the year had gone, it had been a record one, and they had had the largest accession of subscribers they had ever had in any year of the company's existence. Out of the available balance of £178,963, a dividend of 6 per cent. on the ordinary share capital was recommended. With respect to the capital expenditure that must always go on, for they could not expand the business without money, and if they were to go on in the same ratio as they had last half-year—an addition of 17,000 subscribers—they must have more money to meet the large expenditure involved. In the half-year under review, £372,000 had been expended on capital account in the erection of 10,479 additional exchange and private lines, and in the construction of underground lines. Their system was undergoing a gradual change; the vital feature being that they were getting under the earth, and a very large sum of money had been spent in the last few years in placing the wires underground in Liverpool, Manchester, Birmingham, Bradford and many other places. They estimated that at the present moment they had about £750,000 lying in the earth, but, of course, in laying out a new system they allowed for an expanding business. There it was, however, lying ready to be utilised as the wants of the community increased. Of course, interest had to be paid on that money, but still the shareholders had a fair dividend, and were in possession of a latent power which would enable them, at a comparatively small cost, to greatly increase the number of subscribers, so that the cost, which was harped upon by critics as having been extravagant and watered, in due course of time would come down very nearly to the moderate figure which the enthusiastic promoters of new schemes believed to be the approximate one. That, however, could only be in a great undertaking, and not in a small one.

Lord Harris seconded the motion, and it was carried unanimously without discussion.

The meeting was then made special, and the Chairman moved a resolution giving power to increase the capital of the company by £2,000,000 by the creation of 400,000 new ordinary shares of £5 each. He said that might be considered to be a tall order, but still, they had to look things in the face, and that great corporation could only be made efficient by expansion, and expansion meant money. If they went on spending at the rate of £600,000 or £700,000 a year they could not go far without getting into debt, and they must either have behind them the power to meet the debt or stop. He thought their company was likely to go on, and it was time that they had to face a new Government policy, but if they could not get all they wanted they must get all they could. They were, after all, only the licencees of the State and they had now come to an agreement with the Government because they thought it was politic in the interests of the shareholders. They had got to face the competition of the Post Office, but yet they had been so fairly treated in the course of recent discussions with the Government that they were bound to act loyally in assisting them in the object they had in view. How far it would succeed time only would show, but the company must not be behindhand in securing their own position and also in expanding, and honestly and in good faith see what they could do to make the position of the Government that which they wanted. The Government wanted to popularise the telephone, and the company would do its best to help that policy forward. In moving the resolution, he would warn nervous people that it did not mean they were coming forward at once for £2,000,000, but they believed that it would be wise to be armed with the power to raise the money.

The resolution was seconded by Lord Harris and carried.

British Electric Transformer Manufacturing Company, Limited.

The *Times* contains a report of the first ordinary meeting of this company held at Faraday House, Charing Cross Road, Mr. R. Stewart Bain presiding.

In moving the adoption of the report, the Chairman stated that prior to the completion of the company's works in October last, the manufacture of their transformers had to be carried on in a temporary workshop, which was found to be both inconvenient and expensive. The shareholders might take it that the first three months of the period under review were not profit-earning, although the time was usefully employed in bringing the transformers prominently under the notice of future customers and in organizing the staff. On the whole, he thought that they had every reason to be satisfied with the results achieved during the nine months that they had been working in their own factory. Turning to the profit and loss account, he pointed out that the total sales, after deducting returns, amounted to £10,991. Of this sum, £5,633, or over 50 per cent, represented the sales of the three months ended June 30th last, thus showing that as their organization became perfected their capacity of output increased more than three-fold. He regarded this as a very encouraging feature in relation to the future of the company. The item of £1,623 represented the value of the work in progress at the close of the financial year. It was only taken at cost, and would, of course, show its due proportion of profit when completed. The remaining items brought up the total amount on the credit side of the profit and loss account to £12,835. On the debit side they had the aggregate manufacturing costs figuring at £10,230. This was more than it would have been but for their having to occupy temporary workshops from June, 1898, to the following October. Against this, however, must be placed the fact that the prices of copper, iron, and other materials had increased during the past six months. The general charges, £942, could not, he thought, be considered extravagant. His own feeling was that if it were desired to make a business pay they must commence by studying the strictest economy during its early years. As proof that the directors practised what they preached, he might state that, of the fees due to them, £669, they had relinquished £369. The amount drawn about recouped them for their out-of-pocket expenses in attending to the company's affairs. Out of the balance available for distribution the board recommended the payment of a dividend of 6 per cent. on the subscribed capital, leaving £237 to be carried forward. To the sum of £25,000 the cost of patents as per agreements of March and May, 1898, there had to be added £250, being the expenditure during the year in obtaining additional foreign patents. The company's transformers were covered by letters patent in France, Belgium, Italy, Austria, Switzerland, the United States, New South Wales, South Australia, West Australia, Queensland and Tasmania, and an application had been made, and was now under consideration, in regard to Germany. The question of how these foreign patents should be dealt with was a matter which was occupying the attention of the board. The directors attached considerable value to them, but whether they would be sold or worked by this company was a subject for future decision. Already the board had been approached with a view to the sale of some of them. Referring to the company's prospects, he said that, at the date of the report, they had orders on hand amounting to £9,260, which was nearly equal to the sales of the period under review, and additional orders had come in since. Their working capital was very small, and they had to deal with the fact that one of the conditions of municipal contracts was, that from 10 to 20 per cent. of the amounts represented by such contracts was retained for a year. The board had, therefore, resolved to issue a further 5,000 shares, which would be offered at par, to the subscribers for the original capital. He could not afford the shareholders better proof of the directors' confidence in the business than by stating that it was their intention, as well as that of the officials, to put more of their own money into the company.

Mr. Reginald J. Wallis-Jones having seconded the motion, it was unanimously agreed to.

W. T. Henley's Telegraph Works Company.

On Tuesday at Cannon Street Hotel, Mr. Sydney Gedge, M.P., presiding, the resolutions passed at the extraordinary meeting held on July 31st were unanimously confirmed. At a subsequent meeting of preference shareholders a resolution was passed ratifying the agreement of July 19th between George Sutton on behalf of the holders of the preference shares of the company of the first part, Arthur Edward Salmon on behalf of the holders of the ordinary shares of the company of the second part, and the company of the third part, and declaring the same to be binding on all the holders of the preference shares of the company. And at a third meeting of the ordinary shareholders the agreement was also ratified.

The Hampstead Electric Supply Company.

A meeting of this company was held last Friday at Winchester House, the Chevalier Soares presiding. The object of the meeting was to pass certain resolutions altering the articles of association, as the company had applied to the Stock Exchange Committee for a settlement, and they, in compliance with their regulations, wanted the various alterations made. The chairman moved the adoption of the resolutions, Mr. Watling seconding, and they were carried. A confirmatory meeting will be held in due course.

British Electric Works Company, Limited.

The first general or statutory meeting of the shareholders in this company, of Birmingham, was held, on 14th inst., at the Law Association Rooms, Cook Street, Liverpool.

Mr. W. M. Brigg, in addressing the shareholders, said that the meeting was a formal one. He thought they might congratulate themselves on the fact that the whole of the capital had been subscribed, and that they had come into possession of exceptionally good works—works that were designed and intended for the cycle trade, but which lent themselves very well indeed to the business the company had in view in taking them over, which was largely the manufacture of electrical fittings. The articles they produced were meeting with a very ready and very acceptable sale. They had been introduced to and were being taken up by the Government, the Post Office, and the Naval Department, and the company's name was on their list. Since the middle of May, when the company actually came into possession of the property, they had had a good deal of machinery to alter and to adapt to the particular purposes required, and they were now really beginning to reap a benefit. They had a good many orders on hand and a good many more in prospect. He hoped that the business would go on as it had begun, and increase and develop, and that at the end of the financial year they would have a dividend to declare.

Hong Kong Electric Company, Limited.

The tenth ordinary yearly meeting was held at the offices at Queen's Buildings.

Mr. H. L. Dalrymple (the chairman) congratulated the shareholders on the further increase in the company's business, the gross earnings showing an increase of upwards of $21,000. The increase had spread almost equally over all branches of the company's business, with the exception of arc lighting, which has remained stationary. During the 12 months under review they carried out a large number of installations, and at the present moment have a considerable amount of installation and other work in hand, all of which will increase the demand for lighting. The board still continue the policy of installing the light at as near cost as possible. The chairman proposed that the report and accounts as presented be adopted, that a dividend of 6 per cent. (60 cents per share), absorbing $18,000, be declared, and that $17,354.23 be written off plant account for depreciation.

Mr. Veitch seconded, and the motion was carried.

Blackpool and Fleetwood Tramroad.—At the half-yearly meeting of this company, held on 15th inst., Mr. G. Richardson, the chairman, said that they had conveyed 620,000 passengers during the past six months. The total receipts during that peri d amounted to £9,991. From July 1st to August 12th the receipts were £7,981, and they had carried only one-third less passengers during that time than during the whole preceding half-year. An interim dividend of 6 per cent. was declared, and £390 carried forward.

Stock Exchange Notices.—Applications have been made to the Stock Exchange Committee (1) to appoint a special settling day in and to grant a quotation to Giffre Electro-Chemical and Power Company, Limited—110,000 £1 shares, fully paid, and to allow the following securities to be quoted in the Official List:—Imperial Tramways Company, Limited—10,000 6 per cent. cumulative preference shares of £10 each, fully paid, Nos. 1 to 10,000, 20,000 ordinary shares of £10 each, fully paid, Nos. 1 to 20,000, and £200,000 4½ per cent. first mortgage debenture stock.

The Hove Electric Lighting Company, Limited.—The directors have declared an interim dividend at the rate of 6 per cent. per annum for the half-year ended June 30th last; the dividend will be paid on October 15th next.

TRAFFIC RECEIPTS.

The Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending August 12th, 1899, were £2,167 18s. 5d.; receipts for week ending August 12th, 1898, £1,223 8s. 4d.; aggregate for half-year to date, £7,981 4s. 0d.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending August 11th, 1899, were £4,489 1s. 5d.; corresponding period 1898, £2,869 19s. 7d.; increase, £1,619 1s. 10d.

The City and South London Railway Company.—The receipts for the week ending August 13th, 1899, were £1,033; week ending August 14th, 1898, £923; increase, £110. Total receipts for half-year, 1899, £6,666; total receipts corresponding period, 1898, £6,784, decrease, £118. Miles open, 8½.

The Dover Corporation Electric Tramways.—The receipts for the week ending August 12th, 1899, were £334 5s. 3d.; week ending August 13th, 1898, £259 13s. 7d.; increase, £74 2s. 8d. Total receipts to date, 1899, £5,819 10s. 10d.; corresponding period, 1898, £4,706 12s. 4d.; increase, £1,112 18s. 6d. Miles of track open, 1899, 8; 1898, 8. Car miles run, 1899, 4,667; 1898, 3,845. Number of cars, 1899, 12; 1898, 10.

The Dublin United Tramways Company.—The receipts for the week ending Friday, August 11th, 1899, were as follows:—D. U. T. Co., horse cars, £2,274 8s. 7d.; ditto, electric cars, £1,353 9s. 5d.; D. S. D. Co., electric cars, £1 284 5s. 8d.; total, £4,911 18s. 8d.; corresponding week last year—D. U. T. Co., horse cars, £2 608 3s. 0d.; ditto, electric cars, £539 11s. 11d.; D. S. D. Co., electric cars, £1,036 17s. 6d. total, £4,174 12s 5d.; increase, £737 6s. 3d. Aggregate to date, £27,670 17s. 10d.; aggregate to date last year, £26,920 9s. 5d.; increase to date, £750 8s. 5d. Worked:—The mileage open is 18 miles electrically, 26 miles by horses, as against 12 miles electrically, and 30 miles by horses, for the corresponding period last year.

The Liverpool Overhead Railway Company.—The receipts for the week ending August 13th, 1899, amounted to £2,704; corresponding week last year £1,743; increase, £331.

The South Staffordshire Tramways Company.—The receipts for week ending August 11th, 1899, were £987 2s. 6d.; aggregate receipts for 32 weeks, £20,954 10s. 11d.; week ending August 12th, 1898, £580 16s. 3d.; aggregate receipts for 32 weeks, £19,853 3s. 2d.

STOCKS AND SHARES.

Wednesday Evening.

A pleasant little rise has at length come to infuse some cheerfulness into the electric lighting market, and, although prices in the list do not show much appreciable change, the quotations are nearly all "harder." There are now to be found buyers at the middle prices instead of sellers, and with the brighter tone prevailing, the buying element came to the front with boldness. City of Londons present almost the only dull feature in the coterie, and the hopes of shareholders appear to be fast vanishing the nearer the quotation approaches its par value. A time of great stress seems to lie before the company in the immediate future, and although it will probably weather this storm as gallantly as it has passed through others, it is certainly a difficult position for the company at present.

On the other hand, Charing Cross have risen, and it is thought that the directors will have very little difficulty in raising the new capital that will be required before the company can supply current in the City. It is believed that at least 1¼ million sterling will be required before effective competition can be commenced.

London Electric Supply Preference have been bought, and there has been some demand for the Preference shares of the House-to-House Electric Supply. South London Electricity have shed a small fraction, sellers predominating in the market.

The electric railway market has also been firm, the feature being a rise in Waterloo and City Ordinary. This was due chiefly to the optimistic tone of Mr. Portal at the meeting last week, whose speech was very favourably received in the Stock Exchange. Considering that the company is only in its infancy, as the chairman remarked, its progress appears to be distinctly encouraging to the stockholders. We adhere to our opinion, however, that the latter are not likely to get more than their guaranteed 3 per cent. for some few years to come. Of course, the company has the inestimable advantage of being backed by the London and South-Western Railway, without whose aid a different story would probably have been told, and the price of the Ordinary stock might have stood nearer that of the pioneer electric railway, the City and South London. The "City" Company would, in all likelihood, do much better business did it adopt a more generous scale of fares, that in force at present tending rather to foster irritation among passengers than to attract them. Central London shares present an unchanged front; the partly-paid capital is to be called up in a day or two.

Tramways Union shares are 8¼—⅜, but very few change hands, as shareholders are looking forward to obtaining a better price should the company be able to go into voluntary liquidation after the sale of the last, *i.e.*, the electrical part of its lines.

Telegraph issues have fallen into a state of holiday quiescence, and scarcely a rise or fall marks the calm stillness of the share list. It has been finally decided that the Telegraph Construction and Maintenance Company should have the manufacture and laying of the new German trans-Atlantic cable to New York. It is a remarkable fact that there should be no German company able to undertake such a contract, but the foundation stone of competition has already been laid in Germany, and the provincial markets are shy of raising the price of Telegraph Construction shares, which already stand at a very substantial premium. Electric Construction 4 per cent. First Debenture were inquired for by a small buyer, with the result that the price has been raised a point.

Aluminium "A" shares continue dull, and [the excellent report lately issued has had no effect in stimulating an upward move. The Hampstead Electric Supply Company has at last awakened to the necessity for obtaining a quotation of some sort in the Official List, and is taking the necessary steps in that direction. The price at present is purely nominal.

National Telephones are steady, but the observations of Mr. J. S. Forbes at the meeting produced no effect upon the price. The company is undoubtedly doing a splendid business, and there seems some justification for the opinion in the Stock Exchange that the price of the shares will touch 6 again before long. There is nothing doing in other telephonic ventures.

A prospectus has reached us, marked "Strictly Private and Confidential" of the United Kingdom Tramway Light Railway and Electrical Syndicate, Limited. The Syndicate starts with a modest capital of £20,000, and its scope lies in acting as a parental company to new electrical railway undertakings, and the like. Various concessions have already been obtained in different parts of England, the most important being in North-east Durham. The Syndicate appears to possess some chance of success, but its shares are at present, we understand, all held privately

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation, August 9th.	Closing Quotation, August 16th.	Business done during week ended August 16th, 1899. Highest.	Lowest.
124,400£	African Direct Telegraph, 4 % Debs.	100	...	...	...	100 —104	100 —104	...	...
25,000	Amazon Telegraph, shares	10	...	...	...	3 — 4	3 — 4	...	...
125,000	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	...	...	...	85 — 90	85 — 90	...	...
905,560£	Anglo-American Telegraph	Stock	£2 13s	3 %	£3 9s	62 — 65 xd	62 — 65	63½	62½
3,047,220£	Do. do. 6 % Pref.	Stock	£5 6s	6 %	6 %	114 —115 xd	114 —115	115	114½
3,047,220£	Do. do. Deferred...	Stock	...	...	18s. %	13⅜— 14½	13⅜— 14½	14½	14⅜
205,151	Brazilian Submarine Telegraph	10	7 %	7 %	...	15 — 15½	15 — 15½	15½	15
75,000£	Do. do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	107 —111	107 —111	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	4 %	...	2½— 3	2½— 3 xd	...	...
10,000,000$	Commercial Cable	$100	8 %	8 %	8 %	188 —193	188 —193	...	...
1,332,523£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	104 —106	104 —106	105½	...
224,850	Consolidated Telephone Construction and Manufacturing	10/-	2 %	1½ %	1 %	⅛— ¼xd	⅛— ¼	...	...
16,000	Cuba Telegraph	10	8 %	7 %	8 %	9 — 10	9 — 10	9⅜	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	18½— 19½	18½— 19½	...	...
12,981	Direct Spanish Telegraph	5	4 %	4 %	...	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	...	9½— 10½	9½— 10½	...	...
30,000	Do. do. 4½ % Debs.	50	...	...	...	103 —107%	103 —107%	103½	...
60,710£	Direct United States Cable	20	3 %	3½ %	3½ %	11⅜— 12¼	11⅜— 12¼	11⅞	...
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	100 —103	100 —103	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	6½%	7 %	7 %	151 —156 xd	151 —156	154	152
1,795,000	Do. 3½% Pref. Stock	100	...	...	...	98 —102 xd	98 —102	100	99½
89,900	Do. 5 % Debs., repayable August, 1899 ...	100	5 %	5 %	...	101 —104	101 —104 xd	...	...
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	115 —120	115 —120	117½	115
250,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	14½— 15	14½— 15	14⅝	14½
16,200£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	5 %	...	99 —103	99 —103	...	...
64,400£	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	5 %	...	100 —103	100 —103	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	...	114 —119 xd	114 —119	...	...
35,100£	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	...	...	99 —103	99 —103	...	...
46,500£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	...	...	100 —103	100 —103	...	...
300,000£	Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909	100	4 %	...	...	101 —104 xd	101 —104	...	...
200,000£	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	4 %	...	...	102 —105%	102 —105%	...	...
180,227	Globe Telegraph and Trust	10	4½ %	4½ %	5½ %	10⅜— 11¼	10½— 11	11⅛	10⅝
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6 %	15¼— 15¾	15 — 15½	15⅜	15¼
150,000	Great Northern Telegraph, of Copenhagen...	10	10 %	10 %	...	30 — 32	30 — 32	...	...
80,500	Halifax and Bermuda Cable, 4½% 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	100 —103	100 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	48 — 52	48 — 52	...	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	6 %	...	109 —112	109 —112	...	...
71,000	Montevideo Telephone, Limited, Ord., Nos. 1 to 71,000 ...	1	...	...	...	⅛— ¼	⅛— ¼	...	...
84,000	Do. do. 5% Pref., Nos. 1 to 84,000	1	...	...	...	¾— 1	¾— 1	...	...
490,000	National Telephone, 1 to 490,000	5	5½%	6 %	6 %	5⅝— 5⅝	5¼— 5¼xd	5¼	5¼
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	14	13½
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5⅜— 5⅝	5¼— 5½	...	...
1,329,471£	Do. 3½ % Deb. Stock Red.	Stock	3½ %	3½ %	3½ %	99 —102	99 —102	100	99
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	⅞— 1	⅞— 1	...	...
100,000£	Pacific and European Tel.; 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	4 %	...	103 —106	103 —106	...	...
11,839	Reuter's	8	5 %	5 %	...	7 — 8	7 — 8	7⅝	...
3,381	Submarine Cables Trust	Cert.	...	...	...	130 —135	130 —135	...	...
58,000	United River Plate Telephone	5	5 %	6 %	...	4⅜— 5¼	4⅜— 5¼	5	...
151,733£	Do. do. 5 % Debs.	Stock	...	...	...	104 —107	104 —107	...	...
200,000£	West African Telegraph, 5 % Debs.	100	5 %	5 %	...	100 —103	100 —103	...	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	½— 1	½— 1	...	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Braz. Sub. Tel.	100	...	...	...	101 —104	101 —104	...	...
889,521	Western and Brazilian Telegraph 4 % Deb. Stock Red. ...	Stock	...	...	...	103 —106	103 —106	103½	...
88,321	West India and Panama Telegraph	10	1 %	1%	...	1⅜— 1⅝	1⅜— 1⅝	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	6 %	...	10¼— 10⅜	10¼— 10⅜	...	...
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	6 %	...	8½— 9½	8½— 9½	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	...	103 —106	103 —106	...	...
158,100£	Western Union of U.S. Telegraph, 6 % Ster. Bonds ...	100	6 %	6 %	...	100 —105	100 —105	...	...

ELECTRICITY SUPPLY COMPANIES.

80,000	Charing Cross and Strand Electricity Supply	5	6 %	7 %	8 %	9½— 10½	10 — 11 xd	10⅝	...
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	5⅝— 6½	5⅝— 6½	...	...
34,000	*Chelsea Electricity Supply, Ord., ...	5	5 %	6 %	6 %	7½— 8½	7½— 8½	...	...
100,000	Do. do. do. % Deb. Stock Red....	Stock	4½%	4½%	...	113 —115	113 —115	113	...
60,000	City of London Electric Lighting, Ord. 40,001—100,000 ...	10	7 %	10 %	6 %	11½— 12½	11 — 12	12	11¾
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	12½— 13½	12½— 13¾xd	13	12 13/16
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	...	123 —128	123 —128	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	*nil*	*nil*	*nil*	11 — 11¼	11 — 11½	11⅛	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	13 — 14 xd	13½— 14½	14	...
220,000	Do. 4½% Deb. Stock, Prov. Certs (£60% to be paid) Rd.	...	...	...	...	51 — 53	51 — 53	...	...
17,400	Edmundsons Elec. Corp., Ord. Shares 1—17,400	5	...	5 %	7 %	5½— 5¾	5½— 5¾	...	...
19,661	House-to-House Electric Light Supply, Ord., 101 to 19,661	5	...	4 %	6 %	7½— 8½	7½— 8½xd	8¼	8
12,000	Do. do. 7 % Cum. Pref. ...	5	7 %	7 %	...	8½— 9½	9 — 10 xd	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	3¾— 4	3¾— 4	...	...
48,050	Do. do. do. 6 % Pref.	5	...	...	6 %	6½— 7 xd	6½— 7	6⅝	...
100,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	106 —107	105 —107	...	...
62,500	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	5 %	15 — 16	15 — 16 xd	15½	...
22,500	Do. Nos. 62,501 to 85,000	10	...	...	...	14½— 15½	14½— 15½xd	...	...
220,000£	Do. 4½ % First Mortgage Debenture Stock	...	4½%	4½%	...	117 —119	117 —119	118¼	117¼
6,452	Notting Hill Electric Lighting	10	4 %	6 %	6 %	15 — 16	15 — 16	...	...
31,980	St. James's and Pall Mall Electric Light, Ord.	5	10½%	14½%	14½%	16 — 17 xd	16 — 17	16⅝	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 10	9 — 10	...	...
65,000	South London Electricity Supply, Ord., £4 paid	5	...	...	...	4 — 4¼	3⅞— 4⅛	4 1/16	4
79,900	Westminster Electric Supply, Ord., 101 to 80,000 ...	5	9 %	12 %	12 %	14½— 15½xd	14½—15½	15⅝	14⅜

* Subject to Founder's Shares.
‡ Unless otherwise stated all shares are fully paid.
Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.
† Quotations on Liverpool Stock Exchange.
‖ Dividends paid in deferred share warrants, profits being used as capital.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation Aug. 9th.	Closing Quotation Aug. 16th.	Business done during week ended Aug. 16th, 1899. Highest.	Lowest.
60,000	Aluminium "A" shares, Nos. 1—60,000	1	10 %	10 %	...	3½— 3¾	3 — 3½xd	...	...
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	95 —100	95 —100	...	...
80,000	British Electric Traction	10	...	...	6 %	17½— 18½	17½— 18½	18¼	...
10,000	Do. do. 6 % Cum. Pref. 30,001—40,000 (issued at £2 10s. prem. all pd.)	10	...	...	...	14 — 14½	14 — 14½	14½	...
20,000	Do. do. do. Nos. 40,001—60,000	10	...	...	...	13¾— 14¼	13¾— 14¼	14	...
200,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	127 —130	127 —130	129½	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	*nil*	*nil*	...	1¾— 2	1¾— 2	1 13/16	1 13/16
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	*nil*	4 %	...	2⅛— 2⅜	2⅛— 2⅜	2 3/16	...
125,000£	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	110 —114	110 —114	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	101 —104	101 —104	...	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	10 %	12½%	15 %	14½— 15½	13 — 14	14⅞	13⅜
90,000	Do. do 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	112 —115	112 —115	...	...
35,250	Central London Railway, Ord. Shares	10	...	...	...	10½— 10⅜	10½— 10⅜	10⅝	...
178,303	Do. do. do. £8 paid	10	...	...	...	8½— 8¾	8½— 8¾	...	...
61,033	Do. do. Pref. half-shares £3 paid ...	...	...	...	...	2¾— 3¼	2¾— 3¼	...	...
71,447	Do. do. Def. do. £5 paid ...	...	...	...	...	5½— 5⅝	5½— 5⅝	5½	...
630,000£	City and South London Railway	Stock	1 3/16%	1⅜%	2⅛%	67 — 69	65 — 67 xd	...	...
22,500	Do. do. Ord. shares, Nos. 1 to 22,500 ...	10	...	...	...	6½— 6¾	6½— 6¾	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	...	...	3½— 4	3½— 4	3¾	...
100,000	Do. 5% 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	...	...	...	...	99 —102	99 —102	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	5⅛%	6 %	6 %	2 — 2⅛	1⅞— 2⅛xd	...	...
17,139	Do. do. do. "A" Shares, 01—017,139	5	5⅛%	6 %	6 %	4 — 5	4 — 5	...	...
344,023	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	95 — 97	95 — 97	...	...
112,100	Electric Construction, 1 to 112,100	2	5 %	6 %	6 %	2⅛— 2⅜xd	2⅛— 2⅜	2⅜	2⅛
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000 ...	2	7 %	7 %	7 %	3 — 3¼xd	3 — 3¼	3¼	...
140,300	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	101 —104	102 —105	...	...
91,196	Elmore's Patent Copper Depositing, 1 to 70,000 ...	2	...	...	...	⅝— ⅞	⅝— ⅞	...	...
9,600£	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	7 %	7 %	11 — 13	11 — 13	...	...
15,000	Henley's (W. T.) Telegraph Works, Ord.	10	10 %	12 %	14 %	25 — 26	25 — 26	25⅞	25¼
3,000	Do. do. do. 7 % Pref.	10	7 %	7 %	7 %	20 — 22	20 — 22	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½%	4½%	...	111 —114	111 —114	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	10 %	21 — 22	21 — 22	...	...
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	102 —106	102 —106	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	2½%	3½%	3½%	8 — 8¼	7⅝— 7⅞	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	14 — 14½	13½— 14	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	38*— 42	38 — 42	...	...
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	103 —106	103 —106	104	...
13,400	Telegraph Manufacturing, Ord. Nos. 6,601 to 20,000 ...	5	...	...	...	9¼— 9⅜	9¼— 9⅜	...	...
13,400	Do. do. 5% Cm. Prf. Nos. 6,601 to 20,000	5	...	...	...	5⅞— 6¼	5⅞— 6¼	6	...
540,000£	Waterloo and City Railway, Ord. Stock	100	...	...	3 %	101 —104	102 —105	103¾	...

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 8¼—9½.
British Aluminium, Ordinary, 10—11; 7 % Pref., 11—12.
House-to-House, 4½% Debentures of £100, 103—106.
Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12½—13½; 1st Preference Cumulative 6%, £5 (fully paid), 7½—8½. Debentures, 103—106. Dividend, 1898, on Ordinary Shares 10%.
National Electric Free Wiring, 10s. paid, 6s.—8s.
Smithfield Market Electric, 3—4.
*T. Parker, £10 (fully paid), 19.

* From Birmingham Share List.

Bank rate of discount 3 per cent. (February 2nd, 1899).

MARKET QUOTATIONS, Wednesday, August 16th.

CHEMICALS, &c.	This week.	Last week.	Increase or Decrease.
a Acid, Hydrochloric .. .. per cwt.	5/-	5/-	..
a " Nitric .. .. .. per cwt.	22/-	22/-	..
a " Oxalic .. .. .. per cwt.	32/-	32/-	..
a " Sulphuric .. .. .. per cwt.	5/6	5/6	..
a Ammoniac, Sal .. .. .. per cwt.	87/-	87/-	..
a Ammonia, Muriate (crystal) .. per ton	£26	£26	..
a " " .. .. per ton	£24	£24	..
a Bleaching powder .. .. per ton	£5 15	£5 15	..
a Bisulphide of Carbon .. .. per ton	£15	£15	..
a Borax .. .. .. per ton	£16 10	£16 10	..
a Benzole (90 %) .. .. .. per gal.	7/-	7/-	..
a " (50/90 %) .. .. per gal.	5/6	5/6	..
a Copper Sulphate .. .. .. per ton	£25	£25	..
a Lead, Nitrate .. .. .. per ton	£23 10	£23 10	..
a " White Sugar .. .. per ton	£31	£31	..
a " Peroxide .. .. .. per ton	£27 10	£27 10	..
a Methylated Spirit .. .. per gal.	2/9	2/9	..
a Naphtha, Solvent (90 % at 160° C.) .. .. per gal.	5/6	5/6	..
a Potash, Bichromate, in casks.. per lb.	3½d.	3½d.	..
a " Caustic (75/80 %) .. per ton	£24	£24	..
a " Bisulphate .. .. per ton	£35	£35	..
a Shellac .. .. per cwt.	68/-	68/-	..
a Sulphate of Magnesia .. .. per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers .. per ton	£6	£6	..
a " Recovered .. .. per ton	£5 10	£5 10	..
a " Lump .. .. .. per ton	£5	£5	..
a Soda, Caustic (white 70 %) .. per ton	£7 10	£7 10	..
a " Crystals .. .. .. per ton	£3	£3	..
a " Bichromate, casks .. per lb.	2¾d.	2¾d.	..
METALS, &c.			
b Aluminium Wire, in ton lots .. per ton	£294	£294	..
b " Sheet, in ton lots.. per ton	£191	£191	..
p Babbitt's metal ingots .. .. per ton	£90 to £160	£90 to £160	..
c Brass (rolled metal 2" to 12") basis per lb.	8½d.	8½d.	..
c " Tube (brazed) .. .. per lb.	10½d.	10½d.	..
c " Wire, basis .. .. per lb.	8½d.	..	..

METALS, &c. *(continued)*.	This week.	Last week.	Inc. or Dec.
f Ebonite Rod .. .. .. per lb.	8/-	8/-	..
f " Sheet .. .. .. per lb.	5/-	5/-	..
g Copper Bars .. .. .. per ton	£88	£88	..
g " Wire (basis price) .. per lb.	10½d.	10½d.	..
g " Sheet .. .. .. per ton	£88	£88	..
g " Rod .. .. .. per ton	£88	£88	..
h German Silver Wire .. .. per lb.	1/6	1/6	..
h Gutta-percha, fine .. .. per lb.	6/-	6/-	..
h India-rubber, Para fine .. per lb.	4/1 to 4/3	4/3	..
i Iron, Charcoal Sheets .. .. per ton	£18	£18	..
i " Pig (Cleveland warrants) per ton	63/6	68/6	5s. dec.
i " Forgings, according to size per ton	From £11	From £11	..
i " Scrap, heavy .. .. per ton	50/- to 55/-	50/- to 55/-	..
i " Wire galvanised No. 8 .. per ton	£13 15	£12	35s. inc
g Lead, English Ingot .. .. per ton	£14 10	£14 10	..
g " " Sheet .. .. per ton	£15 7 6	£15 7 6	..
m Manganin Wire No. 28.. .. per lb.	8/-	8/-	..
g Mercury .. .. .. per bottle	£8 7	£8 7	..
d Mica (in original cases), small per lb.	1½d. to 6d.	1½d. to 6d.	..
d " " " medium per lb.	1/9 to 2/6	1/9 to 2/6	..
d " " " large per lb.	3/6 to 7/-	3/6 to 7/-	..
p Phosphor Bronze, plain castings per lb.	1/1 to 1/4	1/1 to 1/4	..
p rolled bars & rods per lb.	1/1 to 1/4	1/1 to 1/4	..
p " r'l'd strip & sheet per lb.	From 1/3½	From 1/2½	..
o Platinum .. .. per oz.	£3 10	£3 10	..
p Silicium Bronze Wire .. .. per lb.	10½d. to 1/1	10½d. to 1/1	..
i Steel, Magnet, acc'd'g to desc'p'n p. ton	From £15 to £40		..
i Steel, Magnet, in bars	£58	£58	..
g Tin, block .. .. per ton	£146 10	£146 10	..
g " foil .. .. per lb.	1/6	1/6	..
n " wire Nos. 1 to 16 .. .. per lb.	1/10	1/10	..
p White Anti-friction Metals— "White Ant" brand .. per ton	£40 to £70	£40 to £70	..
j Yarns, Cotton, Single 10lb. bundles per lb.	7½d.	7½d.	..
j " Best Flax, 6 lea. .. per lb.	4½d.	4½d.	..
j " Hemp, 3 ply 10 lbs. .. per lb.	3½d.	3½d.	..
j " " Russian, 10 lbs. per lb.	4½d.	4½d.	..
j " Jute, 180 lbs. rove .. per ton	£13 10	£13 10	..
j " Manila, 24 thread .. per ton	£85	£82 10	£2 10s. inc
k Zinc, Sheet (Vielle Montagne bnd.) p.t.	£28 10	£28 10	..

Quotations supplied by
a Messrs. G. Boor & Co.
b The British Aluminium Company, Ltd.
c Messrs. Thos. Bolton & Sons.
d Messrs. F. Wiggins & Sons

Quotations supplied by
f The India-Rubber, Gutta-Percha, and Telegraph Works Company, Ltd.
g Messrs. James & Shakspeare.
h Messrs. Jackson & Till.
i Messrs. Bolling & Lowe.
j Messrs. Henry C. Yeo & Co.

Quotations supplied by
k Messrs. Morris Ashby, Limited.
m Messrs. W. T. Glover & Co., Ltd.
n Messrs. P. Ormiston & Sons.
Messrs. Johnson, Matthey & Co., Ltd.
The Phosphor Bronze Company, Ltd.

THE MUNICIPAL ELECTRICAL ASSOCIATION.

Discussion on Mr. Edgcome's Paper* on "The Arrangement of Steam and other Pipes, and Their Fittings."

Mr. Ferranti pointed out that there was a great similarity in electricity stations between the system of steam pipes and the switchboard system of communication. With the switchboard, most engineers wished to be able to do everything, and very many complications resulted from its having to fulfil so many requirements. Very much the same thing applied to the system of steam pipes and valves. It was desired to feed every engine from every boiler in every conceivable way. For his part, he would reduce the pipes down to the lowest possible limit. He would give up many conveniences, and would do away with a great deal, provided he could bring the pipes down to an irreducible minimum. They cost a great deal to instal, and a great deal more to maintain. The stand-by losses were, to a great extent, due to pipes, and what was not attributable to pipes was, in a great measure, attributable to valves. In his opinion, the only things worse than steam pipes were valves. For his part, he would rather follow the system of putting the plant into sections than have any complicated system of steam pipes. He would rather see engines with a certain number of boilers sufficient to run and to spare attached to each engine, so that each set formed a complete unit. All that would be necessary in that case would be to have small inter-connecting pipes between the various systems available in case of a breakdown.

Mr. Gibbings (Bradford) said that with reference to the author's description on page 5 of his paper, he had found since his station was first started—practically two years—he had not had to make more than one joint. When the joint had to be made they had the advantage of being able to take out a complete packing ring instead of having to cut a special ring of asbestos or other packing. Instead of connecting the drainage pipes direct from the steam pipes, they had interposed another—a small casting. There was an overflow arrangement in the inside of this circular casting. If the steam trap was not acting properly, it was always easy for the engineer, as he went round, to see that the water was standing at a higher level than it should, that was to say, than the overflow of the water itself.

Mr. Steinitz (West Ham) agreed with Mr. Ferranti as to the complications. He should prefer one single main with a certain factor of safety. The ring main was the invention of the electrical engineer. They did not hear of it in waterworks or such like establishments. They ran more risk by the addition of the ring main than the advantages justified. Where they were using large valves they could make them act as separators by turning them upside down. It was necessary the steam traps should be regularly examined.

Mr. Boot (Tunbridge Wells) said Mr. Ferranti had referred to complicated systems of pipes. They had a steam ring, and they found it of very little use, except to give employment to fitters. They had tried almost every kind of joint mentioned by Mr. Edgcome, and had had trouble with them all. With regard to the question of covering, when they started it was not the practice to cover their valves and their fittings beyond just the ordinary piping, but they found there was a considerable loss occasioned by their not being covered, and about a year and a half ago they decided to cover every valve. The result in economy had certainly been remarkable. It seemed only a small matter, but it was extraordinary to notice the difference in temperature that it had caused in both the engine room and boiler house, so that the losses must have been considerable from these causes alone. The latest form of covering they had tried was blue asbestos, and he thought that would be satisfactory. Mr. Gibbings had mentioned the question of the reservoir. They some time ago had traps in all their drains, but they gave it up, and did away with traps altogether, bringing all the drain pipes to one large steam reservoir with the arrangement mentioned by Mr. Gibbings. They put in one blow-down pipe and the result had been satisfactory.

Mr. Chamen (Glasgow) said he was glad attention had been called to the question of steam rings, and he reminded the meeting of the terrible affair which happened at Kensington Court in the early days. He agreed entirely in this matter with Mr. Ferranti, who, he thought, had put the whole case most clearly, and the arrangement he had described was practically what he had decided to introduce in Glasgow. He had a 15-inch steam main which he had put at the highest point inside the boiler house, the connection from the boiler running up to that. That main was broken at intervals, and he had an arrangement to connect the various parts by small pipes. The only place where he thought it desirable to have a steam trap was the engine separator. Reference had been made to the question of recessed pipes. While of service in keeping the joints in sound condition, it had presented difficulties in case of repair, and he preferred the arrangement suggested by Mr. Edgcome. With regard to explosion valves mentioned on page 8 of the paper, Mr. Edgcome did not mention the double-acting valve which was in use on the Babcock boiler. As to blow-off valves, he did not think they ought in future to have the boilers' blow-off valves discharging into a common pipe, particularly in large stations. There might be a leakage to be dealt with, and there would be difficulty in finding out exactly where it was. His idea was that each blow-off valve should discharge into a separate culvert, and that in each case there should be ample facility for inspection. The engineer would, of course, take care that there were periodical examinations. In his remarks he had let the valve makers alone. Their consciences would tell them what to suggest.

Mr. Mountain (Huddersfield) thanked Mr. Ferranti for trying to standardise their steam pipes in the way he had done, although it was an expensive item. There could be no doubt they were forced to have some system of duplicate pipes. Describing the system he had adopted for draining the pipes, he said he did not have any steam traps at all; he simply drained his water to a cast-iron cylindrical vessel, whence it was taken up to a condensing tube in the roof and then conveyed directly back to the boiler. Really it was nothing more than the American system of returning condensed water, but it worked well, and they could be absolutely sure the pipes contained no water. As to the covering of the exhaust pipes, he had trouble with the heat in his engine room, and he put a casing round the pipe and let his feed water go through it. That accomplished the double process of cooling his engine room and heating his feed water. He thought if that plan were adopted it would help to economise.

Mr. Hopkinson said he was afraid the poor valve makers had a lot to answer for. It was not, however, altogether the construction of the valves, but the way in which they were used. In order to ensure their being fairly tight, valves should be closed regularly, say, two or three times a week. They were often spoilt in the first two or three days of working. If the gentlemen present could arrange some means of having their pipes cleaned before erection the trouble from valves would be largely reduced. Mr. Chamen had referred to an explosion valve, but that was not exactly the valve referred to by Mr. Edgcome. His was an isolating valve, which automatically cut off the boiler, not in the event of a large escape of steam, but immediately the pressure fell.

Mr. Ruthven Murray remarked that this was a subject of very great interest to them all, because they all had steam pipes—they even found them in water-power stations. He thought insufficient attention was, as a rule, given to providing for the expansion of pipes. They had also to provide for draining the pipes, though he dared say, by the use of superheated steam, the necessity for drainage was less than it formerly was. As regarded the means of providing for expansion, there were practically two; one was by the elasticity of the pipes, in which case they must use bends, and it was advisable to keep the pipes comparatively small in size. He thought on large steam mains Mr. Wordingham had done this by putting a series of small pipes parallel, which ought to get over the difficulty very nicely. The second way was by mechanical expansion joints, which some of them had not found satisfactory. There was a great deal of danger in the use of copper. In the matter of the blow-off valves, his practice had always been to fit on the blow-offs a valve, then a cock in series. He thought the danger Mr. Edgcome had referred to of getting steam back into a boiler might be easily and satisfactorily overcome by putting a back pressure valve on the blow-off.

Mr. Fletcher (Ashton-under-Lyne) confessed that he had listened with very great interest to the paper given by Mr. Edgcome, but he would like to point out that the valve makers were not always at fault; the blame often rested with the electrical engineers. References had already been made to foreign matter coming into the valves. He had frequently experienced that, and sometimes he had found a great part of the building inside. The by-pass was an important matter in all these things. Standardising would, he thought, save a good deal of trouble.

Mr. Wordingham (Manchester) thought the question of steam pipes was, perhaps, one of the most difficult in a central station, and it certainly was one of the most fruitful sources of worry. Mr. Ferranti's remarks referred chiefly, he thought, to large stations. He thought, however, that whether the station was large or small, it was wrong to let it depend upon a single joint in a steam pipe. They must have some means of getting around that joint, either by a ring main or a complete set of duplicate mains, and, to his mind, the latter plan offered special advantages. Seeing that they had two connections from each boiler and engine, one to each steam pipe, it followed that if they had leaky valves they were sometimes difficult to trace. It was important that there should be facilities for easily testing where the leakage was. Now in a large station the difficulties of steam pipes were enormously accentuated, because although they were growing larger units every day in their generating stations, it was very difficult to get a larger unit in boiler power. In the last station he was designing they would probably have 11 units for the generators and something like 120 units for the boilers. He did not think they wanted to carry the duplication of the steam pipes right away to every boiler. He had adopted a unit of seven or eight boilers, and there would be a duplication in the engine room, but in a sense it would not be a complete duplicate. He thought something on those lines was what was really wanted. He agreed with Mr. Ferranti that they did not want a lot of complication, but he did not agree with him if he meant that they ought only to have a single pipe on which to depend. He understood Mr. Ferranti to suggest that there should be a reserve of sections, and if so he thought there was a good deal to be said for it.

Mr. Ferranti: That is right.

Mr. Wordingham quite agreed that they only needed small interconnections. He was glad to have heard a little bit about Mr. Mountain's gravity return system, and would like to hear more. In Mr. Edgcome's paper he showed some cross-connections in his steam ring. He (Mr. Wordingham) thought that if carried out in the way suggested there would be a great amount of trouble with the expansion of the two legs of rings. One of the most important things was the question of expansion joints. He did not think there was any joint so called that was of any use, and he had had to fall back upon bent steam pipes. Mr. Edgcome apparently advocated automatic valves. To his mind, the fewer automatic things they could have about an engine house the better. As to the high steam and low water valve that they found on the Lancashire boiler, he thought it absolutely useless. As to pipe covering, he did not think accessibility to the pipes themselves was necessary, but they must have access to the joints, and therefore to that extent it must be a removable covering. If they desired a nice little engine room, it was necessary to cover the cold water pipes, otherwise the condensation of water on those pipes would cause a deal of rust.

Mr. Snell believed the best type of steam joint was the corrugated

* Electrical Review, August 11th, 1899, page 251.

ring. With regard to drainage, he did not like the idea of turning his valves upside down.

Mr. Ram suggested that if possible many boiler coverings actually helped to keep the pipes cool rather than warm.

Mr. Andrews (Hastings) wished to say a word in support of the steam ring. About six years ago they put in a steam ring at Hastings, and for four years they never had occasion to use it, and he began to look upon it as an unnecessary complication. They then had occasion to extend the ring to couple up a new boiler, and during that time a joint blew, and they had their lights out in the town for about half an hour. They must have duplicate feeders. It was absolutely necessary to provide against a fault in any part of their system cutting off the whole supply.

The Chairman, Mr. J. H. Rider, said he would like to add a few words before Mr. Edgcome replied. In the first place, he totally disagreed with the author in his advocacy of the steam ring. He thought it was time the steam ring was killed, and he thought the ring Mr. Edgcome had designed in his drawing was bad, even for a steam ring, because instead of taking his steam branches from the same side of the ring to which the boilers were connected, he took them from the opposite side. He thought he should take them from the same side, and use his ring entirely in the boiler house with the lower half having no branches at all, so that the lower part could be used as a drain. He agreed with what Mr. Ferranti had said. Supposing they had half a dozen boilers in a station, they could get all possible necessary combinations by coupling these boilers directly to their engines and by putting in a small connecting pipe. The extra advantages they were supposed to get from the steam ring and the inter-connecting devices were more than upset by the trouble of condensation and the trouble of getting water into the pipes if they were kept off except in cases of emergency. He hoped the meeting would condemn the steam ring, and let it go forth that it did not like it. He was sorry that the gentlemen who claimed to have discovered such good steam traps would not tell them where they came from, because they were things which they all desired. He thought one of the advantages of the Association should be to give information of that kind. He quite agreed with the jointing arrangement suggested, viz., corrugated brass rings. As to valves turned upside down and the liability to leakage through the glands, he knew a station where the valves were turned upside down, and he did not think a cupful of water had come out of those valves during the last two years. As to pipe covering, he certainly thought that covering for the flanges was quite as necessary as the covering for the pipes. In most stations there was a large area of joints open to the atmosphere which ought to be covered, but it was, of course, necessary that the covering should be removable in order that they might get at the joints when necessary. They were indebted to Mr. Edgcome for the able manner in which he had brought the subject forward, and he was sure they would give him their hearty thanks.

Mr. Edgcome, in his reply, said that when he got back he should start pulling down his present steam ring and arrange a station on the Clay-Rider system. With reference to the remarks of Mr. Steinitz, he thought they were answered by the fact that until the electrical engineers took the question in hand no other engineers took the trouble to give a duplicate supply of steam pipe—due to the fact that until the electric supply stations were running there was no necessity for absolute continuity of running. With gas and water works there was always a large amount of storage. With other works it caused inconvenience, but it did not advertise itself in the same way as with electric light plant. When something went wrong at other works no one knew anything about it. Various hints had been given in the course of the discussion as to special information which some of the members possessed, and he hoped at the close of the session when the reporters were not present they would tell their colleagues these good things.

PROF. KENNEDY'S REPORT TO THE LONDON COUNTY COUNCIL ON MECHANICAL TRACTION ON TRAMWAYS.

Report by Alex. B. W. Kennedy, F.R.S., &c., to the Highways Committee of the London County Council.

17, Victoria Street,
Westminster, S.W.,
June 5th, 1899.

To the Clerk of the London County Council,
Spring Gardens, S.W.

Mechanical Traction on Tramways.

Sir,

In your letter of March 3rd last you communicated to me the following resolution of the Highways Committee of the London County Council:—

"That, taking into account all of the varying circumstances, present and prospective, of tramways in London, Mr. A. B. W. Kennedy, F.R.S., do report to the Highways Committee his opinion (*a*) as to the best system or systems of mechanical traction, other than steam or cable, for adoption, on the tramways, (*b*) where, or under what conditions, an experimental line could best be introduced to initiate such system or systems, and (*c*) generally on the whole subject."

I have now pleasure in making my report to your committee, in accordance with this resolution, upon the matters referred to me.

I should like to say, in commencing, that in view of the enormous importance of this matter to London and the very great complexity of the problem as applied to London, and in view also of the very rapid extension in the use of mechanical traction which has taken place during the last few years on the Continent and in America, I have thought it desirable, before reporting to you, to make special visits to those cities both in Europe and in America in which there now exist traction systems having special interest, or containing features which seemed possibly or probably to be of value, in connection with the special problem of mechanical traction in London. I have very great pleasure in acknowledging that during these visits made on your behalf I have received most valuable information and courteous help on all hands from engineers, tramway officials and manufacturers, for which I am greatly indebted.

I do not propose to describe in detail any of the visits which I have mentioned, but will confine myself solely to dealing with the matter as it affects London and as it has been referred to me. If your committee wish to have before them detailed descriptions of systems used elsewhere I shall be very glad to add them to this report at any time, but these are probably the less wanted as very excellent descriptions of some of the most important works have recently been placed before your council in the illustrated report drawn up by one of their members, Mr. J. Allen Baker.

(*a*) As the use of steam and cable for the trams is specifically excluded from the reference to me, there remain only, as systems of mechanical traction, the use of gas or compressed air, or of electricity.

As to the two first, if they could be successfully carried out on a large scale, they would certainly have the advantage that the cars would be self-contained and independent of each other or of any overhead or underground work. Any breakdown would therefore be that of one car only and would not affect the general system. I consider that this is a real and great advantage, and an advantage quite sufficient to outweigh smaller drawbacks if the systems in question were in other respects sufficient and satisfactory. Unfortunately, however, neither of them has yet attained sufficient success to warrant me in recommending their use on London tramways in the present state of the engineering problems connected with them. The cars to be used in London must be so large and heavy, and the power required in each so considerable, that the use of reciprocating engines (whether gas or compressed air) of sufficient power as motors is accompanied by many difficulties; in fact, I do not think that really suitable engines for this particular purpose have yet been designed. On a small scale, gas trams are running with considerable economy in the north of England, where I have examined them, and compressed air tramcars are going to be tried for a portion of the cross-town traffic in New York. I had the advantage of seeing these last cars during my visit to America, but they were not at the time in actual work.

Further, as to the use of gas or compressed air, I think I need only point out that if during the time occupied by the construction and running of your experimental line such advances should be made in the matter of gas or air engines as to render it advisable to consider this matter further, tramcars so propelled could quite easily be worked along with others on your lines in case circumstances arose which rendered such trials in any respect desirable.

As to the use of electricity, there are, as you know, various systems possible and in use. These are—

1. The ordinary overhead system, in which the current is carried from an overhead wire to the motor, and returned by the rails themselves to the station.

2. The underground conduit or slot system, in which (with the exception of one type) both conductors are insulated and are carried in a conduit underground, from which the current is transferred to the motor in the car by means of a plough working in a slot in the roadway.

3. Various underground surface contact systems in which no slot is used.

4. Systems using batteries as a sole means of propulsion, or batteries in combination with overhead conductors.

Taking the above possibilities in electric traction in the order in which I have mentioned them, the overhead system is, of course, by far the most used. Its great advantage is that it does not require any special interference with the roadway beyond that necessary for laying the lines of the tramways in any case;* and, further, that more experience has been obtained in connection with this than in connection with any other system. When carried out as roughly as it has frequently been carried out in America, its cost is very much less than that of any underground system. Carried out, as it is necessary to carry out such a system in this country, the difference of cost is not nearly so great. This difference will always, however, be considerable in cases where there are a great many pipes below the road near the surface which have to be shifted or otherwise dealt with. For this reason the overhead system has naturally commended itself to private tramway companies, and also to municipalities in comparatively small towns where the traffic could not be expected to be sufficiently large to pay on an increased capital. The overhead system is capable of giving any reasonable amount of power and any required speed of cars.

In straight roads or streets its disadvantages are at a minimum, the most obvious being the line or lines of poles (in London streets there would generally have to be a line on each side of the road), with the span wires connecting them, the trolley wires, &c., these being at a height of something like 20 feet from the road. Apart altogether from the much vexed question of appearance—as to which there is so great a difference of opinion—I cannot help doubting whether any system of overhead wires can really be regarded as likely to prove a permanent and final solution of the traction problem in a great city like London. But leaving aside this general question, I have to

* In this country the feeders would, of course, be laid underground, but these do not require any such depth of excavation as to be seriously inconvenient.

point out that at crossings and street junctions (of which there are an enormous number in the tramway systems of London) the trolley system is inevitably accompanied by such a metallic network overhead as in my opinion to put it altogether out of the question in busy London streets. If any private company asked permission from a committee of the London County Council to erect at any one of a dozen junctions which are shown on the tramways map, such arrangement of poles, span wires, stays, guys, conductors, &c., as are necessary with an overhead system, and as are to be seen in certain cities, I feel certain that the proposal would be met by an absolute and unconditional negative. So far as my own opinion is concerned I do not think that it would be advisable or even permissible to use such a system in such places as I have mentioned. This difficulty affects nearly all the tramways north of the Thames, and it affects the South London tramways over an area roughly about two miles wide, and parallel to the course of the Thames, between Deptford Reach and Chelsea Reach.

South of the Thames and of the limits which I have just mentioned, long lines of trams radiate into suburban or semi-rural districts, these lines being mostly straight, along broad roads and free from junctions. In such cases the disadvantages of the overhead system are at a minimum, and its comparative advantages are greatest. As I shall have occasion to point out later on there is no engineering difficulty whatever in using a mixed tramway system, *i.e.*, partly underground and partly overhead. Whether this is worth while in the case of London is no doubt a matter for very serious consideration, and one which must be, to a considerable extent, decided by the nature of the roads along which the trams are to run and the details of the systems proposed.

I should point out that in any case the overhead system must practically use the rails as return conductor, and must therefore be an earthed system.

2. The underground conduit or slot system is the only one now used in New York, and is partly used also in Washington, in Buda-Pest, in Berlin, in Paris, &c. It is now 12 years since it was first tried in Buda-Pest. The system adopted there was in certain respects tentative, and is in certain important points quite unsuitable for London. Nevertheless, this original system, which is one of the earliest constructed of electric lines anywhere, has worked well and economically ever since its construction, and quite lately it has been much extended, both by the original company, and by a second company following the example of the first one, but with such improvements as later experience has suggested. The American experience in the slot system is more recent, and the results there have also been thoroughly satisfactory. I am glad, therefore, to be able to say, as the result of my examination of the present state of underground electric trams, that the laying out and working of lines on a slot system has already been carried out successfully on a very large scale. Moreover, it must be said that this success has been obtained in spite of a most singularly persistent and not very easily understood opposition. As a matter of fact the cost of power on the two systems (and, what is of equal importance, the cost of maintenance) is practically the same. The drawback of the underground or conduit system is that it certainly costs more per mile of line than the overhead systems. The chief engineer of one of the principal companies using both systems gave me as his experience that where the overhead system had to be provided with underground feeders and with such handsome poles and other appurtenances as would meet the approval of his municipality, the actual difference in cost between the two systems was very inconsiderable. And I have no doubt that the difference has been in the past, for various reasons, very greatly exaggerated. At the same time, however, in addition to the actual increase of capital expenditure due to the system itself, there must be in a place like London very considerable additional expenditure in many places due to difficulties caused by gas and water pipes, &c., which will have to be lowered or shifted or replaced. I have no doubt, therefore, that it is right at this stage to anticipate that any underground system will cost considerably more per mile of line than even a first-class overhead line. I will deal further with this question later on, but here need only point out that the actual amount of the difference in cost will depend on the amount of care given to the details of the design and construction of the underground conduit, in special reference to the particular circumstances and conditions of the London streets.

As to the conduit system itself there are two chief types in use. In one, one of the running-rails is made double, and the slot for the plough is carried down between its two halves, so that the running-rail itself lies directly above the conduit carrying the conductors. In another system the conduit lies in the middle between the rails, and the slot rail is therefore in the middle between the running rails, and is entirely separate from them. In the original Buda-Pest system the slot was about 1½ inches wide, and even now in Brussels the slot is about 1½ inches wide, and of still greater width at the points. Such an arrangement would no doubt be quite inadmissible in this country, and I must say that it appeared to me in some cases dangerous. In New York, Washington, Paris, and other places where the centre slot is used it is only about ⅝ inch wide—a breadth which is not the slightest hindrance or danger to any traffic.*

The conduit system has insulated conductors throughout—that is to say, it does not use the rails or earth as a return. I think this is undoubtedly an advantage so far as it goes, as it obviates as completely as in the case of electric light companies, the possibility of electrolysis due to leakage currents and the disturbance of telegraphs or telephones. The concrete below the central conduit is generally from 2 feet to 2 feet 3 inches below the road surface. Unless large pipes occur within this depth there will not be much trouble; it is only with large pipes occurring nearer to the surface than this that serious trouble is found. I think, however, that it is possible by careful design somewhat to reduce the depth of the conduit, and so reduce the trouble and expense due to this cause.

3. In surface contact systems there is no surface slot rail, but a series of studs, or buttons, or a continuous solid centre rail (divided electrically into sections), whose upper level is somewhat above that of the roadway between the running rails. These studs or rail sections become alive only when the car is actually passing over them and when they are rubbed by a skate or brush carried by and underneath the car itself. In these systems the return current is carried back by the rails exactly as in the ordinary overhead system, so that they have not the advantage of an insulated return. I have examined the working of a number of surface contact systems, some running on a commercial scale, some only experimentally. As compared with overhead lines they have, of course, the advantage of doing away with all poles, wires, &c., above ground. As compared with the conduit system, they are in general cheaper,* certainly in cases where the conduit system requires the removal of pipes under the roadway, for the surface contact system necessitates comparatively little excavation. The studs, or buttons, do not at all seem to be in the way of ordinary traffic, although I think that the raised centre rail which has been proposed in several cases might probably be found inconvenient. In most of the contact systems, however, a serious disadvantage, a disadvantage especially in our moist climate, is the fact that the working of the system depends upon the permanence of a very large number (from 300 to 1,500 per mile of single line) of coils of fine wire placed in switch boxes or in separate chambers underground, along or beside the line. I have been most anxious not to attach an exaggerated importance to this point, but after full consideration I must say that until it is experimentally demonstrated that these coils will remain permanently in good order and well insulated under the conditions of ordinary road traffic in our own country, they appear to me to constitute a serious drawback to the systems in question.

I must add, however, that there is a class of contact systems differing from those I have just mentioned in having electro-magnetic coils only upon the cars and not underground at all. Such coils are very few in number, and the failure of any of them would cause the failure of a car only, and not of a section of line, while they are much more accessible and readily tested and examined than coils placed permanently underground. No large experience has yet been gained in connection with such a contact system as I have just mentioned, but the experience, so far as it has gone, has been favourable, and it appears probable that a system based on this principle may be carried out successfully even under English climatic conditions. A good deal, however, has still to be done in order to work any such system into a form suitable for use under the conditions of London traffic. Equally with the other contact systems, there would in this case be a return by the rails.

4. Batteries of accumulators are used sometimes as the sole means of propulsion (in which case the battery is removable and is taken out of the car after a certain length of journey and replaced by another), or as part of a combined system, where the batteries are charged from the overhead portions of the line as the car is running upon them. In the latter case the batteries are never taken out of the car except for the purpose of overhauling. A battery car has the advantage that it may be made self-contained, so that a breakdown would be that of the car itself and nothing more. The batteries add, however, very greatly to the weight of the car (from 2½ to 4½ tons), their maintenance is very considerable in most cases, and at the best they are practically only suitable for use on level lines as in Hanover or in Ghent, in which latter place especially their use appears to have been attended with great economy, although of course it is only on a small scale. As with gas and compressed air, it will be possible for you at any later time to give a trial to a battery car or cars on your experimental lines if it seems desirable to do so, but I do not advise you at present to enter into any experiments yourselves in connection with this system of traction.

In concluding this section of my report I have to say, after examining very many overhead and underground lines in large cities, and especially after seeing the two systems frequently side by side in the same city, that the general convenience of having the roadway absolutely clear of all overhead obstructions, especially at important street junctions, seems to me so great that even if the extra cost were much more than it is actually likely to be, I think that the London County Council ought to adopt over all the central parts of their lines, an underground system—that is to say, a system in which overhead wires are entirely dispensed with. As to the much vexed æsthetic part of the question, I do not wish to say anything. But I feel certain that in such a large and wealthy city as London, a city where the tramway traffic will be enormous, and especially a city where the tramways are actually in the hands of the municipality, any such overhead arrangements as are inevitable at such places as I have indicated would never be tolerated as more than a makeshift. I believe that if for the sake of saving in the first cost they were to be adopted in London at present, there would before many years be a peremptory demand that they should be pulled down altogether and replaced by something free from these obvious drawbacks.

As to section (*b*) of the reference, I am very glad to understand that the Highways Committee propose to apply mechanical traction in the first instance to an experimental line. That is, as I understand, that they propose in the first instance to apply mechanical traction to only a certain detached section of their whole network, in order to gain such experience in the special conditions of London

* As to this I may mention that in Edinburgh, where a cable line is being laid, and where there is therefore a centre slot rail along the track with a slot ⅝ inch wide, the surface of this slot rail is the favourite line for bicycle riders to follow, as being the smoothest and best part of the street.

* But this would certainly not be the case in several of the systems I have actually examined, unless the conduit were made disproportionately expensive on account of the removal of the pipes.

traffic as may guide them in completing their scheme later on. Such a section or experimental line should be of sufficient length to be in itself a paying concern, and therefore it should be on a well-frequented route. It ought also to be on a route containing good examples of any such surface difficulties (I do not refer to underground pipes) as may be expected to occur in other parts of London. A total length of five or six miles would be sufficient—a much smaller length would hardly be desirable. I find from the drawings kindly sent me by Mr. Gunyon that the line originally proposed for this purpose is already the site of three 30-inch water mains at no very great depth below ground, otherwise the line proposed was in every way suitable. I think, however, that it would be a pity at this stage of the work to deal with a portion of road offering such special extraneous difficulties as this particular road appears to offer. If, therefore, Mr. Baker can, from the point of view of traffic generally, suggest some other line, I believe it would be advisable to adopt it, supposing always that it is not found as difficult to deal with as the first one.

In view of the fact that the County Council have already sanctioned the proposal of a private company to bring a portion of their overhead lines within the county of London, and that this overhead line appears to be in the hands of excellent contractors, and will be subject to the approval of the Council's engineeer, and always accessible for examination by members of your committee, I do not think it will be worth while to fit up any portion of whatever line is chosen for experiment with overhead conductors. I have therefore to recommend to you that a scheme be worked out for fitting up such a line as I have just mentioned with a conduit system, having both conductors insulated. The details of this system will, of course, require very careful working out before tenders are obtained. On such a length of line as that proposed it will be found quite possible—if, on going into details, it is also found desirable—to try more than one arrangement, so as to determine the best for final use. On the same line there could also be tried—if in the progress of the work it seemed desirable—a contact system based on the principle which I have mentioned above.

I have already pointed out that on any experimental line constructed by the Council self-contained cars of any type (gas, compressed air, or battery) could be tested if it seemed desirable to the Council to allow such experiments to be made.

The total power required to work the cars upon such a section of line as I have suggested depends, of course, upon the number and weight of the cars. Assuming, however, that the line is six miles in length, and that there is a two-minutes' service of heavy cars during the busiest parts of the day, running with a maximum speed not exceeding 10 or 12 miles an hour, you would require to provide something like 2,000 H.P. for the work. I fear that it is hardly possible for you to buy continuous current to this amount from any of the private companies supplying electrical energy on the south of the Thames, or at all events, to buy it at any cost approaching that at which you could supply yourselves from a station of your own. This is especially the case, as, while any such arrangement could only be of a temporary character, it would entail upon the company supplying the energy the purchase of a large amount of special machinery. I think, therefore, that it would be most advisable and economical for you to have the plant designed and specified especially in such a way as to form part of the complete scheme which you will be carrying out later on. And if possible, it should be put down on a site which should be the site of one of your permanent power stations, so that it might not have to be removed later on. I quite recognise, however, that it may not be possible to make sure of obtaining this last condition, in which case it must be made certain that the whole of the plant can without more than reasonable inconvenience be shifted into its permanent position later on.

I think I need not point out to you that the questions of the type and weight of the cars, and especially of the speed of running, must be dealt with and settled as soon as possible, as upon these points depend so very much the whole electric equipment of the line.

(*c*) In conclusion, as to the whole matter of mechanical traction in London, I have to say that it is necessary to remember that the conditions of working in London are and will always be very different from those which exist either on the Continent or in America. In some respects the differences will make our working easier, in others more difficult. In particular I should think that it was improbable that the County Council or the police authorities would permit any such speeds to be reached as are quite common elsewhere. I am afraid that it must be admitted that the high speeds which I have found common in very many cities, and which are certainly popular with the people, have been and continue to be the cause of very numerous accidents of a kind which would be considered in this country most serious, and which would, in fact, be sufficient if they occurred here to result in the immediate prohibition of the fast running to which they are apparently due. The rough arrangements of wooden posts and overhead feeders, which are still visible in the streets in many places, would be also impossible here. The breadth of slot also which is used on the Continent would rightly be considered here as inadmissible, if not dangerous to traffic.

In respect also to the amount of the tramway traffic, I wish I could anticipate that it should be as large in proportion as the traffic obtained elsewhere. I have examined, for example, the traffic on 37 of the largest American lines for which statistics are published, and I find that on the average the tramways of these 37 towns carry their whole population in less than six days, and in the cases of large cities, such as Boston, New York, Minneapolis, Troy, &c., a number of passengers equal to the whole population is actually carried by the tramways in less than three days. This is the more surprising when one remembers that the travelling in an American tramcar is one of the most uncomfortable experiences possible, the car being at all busy hours of the day crammed with people standing up as well as those seated in what we consider a legitimate manner. But although it can hardly be expected that the trams of the London County Council shall, for a long time to come, carry two million passengers per diem, it is yet a matter of, I believe, universal experience in this country, so far, that a change from horse cars to the greater speed and comfort of mechanically worked cars is always accompanied by a very large increase in traffic.

I understand that at present, even with your horse tramcars, the difference between receipts and expenses amounts to something like 3½d. per car mile. With mechanical traction your expenses will certainly be diminished and your receipts will be largely increased, unless you balance the greater number of passengers by a very large reduction in average fares, as I presume before long you would wish to do.

It has not been possible, in the time at my disposal, to make accurate estimates of cost, but I may put before you a few approximate figures as some indication to your Committee of what the whole matter means. The present length of tramline in London may be taken roughly as equivalent to 200 miles of single track. On this 200 miles, when working electrically, you might probably have something like 500 cars running, and these cars might make not very far from 20,000,000 car miles per annum. Taking the cost of the lines, cars, and power stations, merely for the sake of assuming some figure, at £15,000 per mile of single track, the total value of the whole tramway system would be £3,000,000 sterling, on which, therefore, £150,000, roughly, would be necessary to provide interest and sinking fund. This, you will see, amounts to 1·8d. per car mile, or just about one-half the present difference between your working expenses and receipts. I hope therefore that the committee will find themselves able to believe that the enterprise in which they are about to embark is one which will not only be for the benefit of Londoners generally, but one also which will pay its way, and on which therefore there would seem to be no reason for grudging such expenditure as to make the whole scheme one of a kind suitable for and worthy of the greatest city in the world. I think it is worth while to emphasise this point because of what I conceive to have been undue emphasis which has been sometimes laid during the last few years on the additional capital expenditure necessary for a conduit line as compared with an overhead system. While admitting to the fullest extent that for a company, whose first business is to earn dividends for its shareholders, the overhead system will appear the most advisable, and whilst admitting also that for small towns where the traffic cannot be anything like as much as, and where the expenditure may be proportionately much larger than in London, it may be desirable on public grounds to limit the expenditure to the lowest possible amount, yet, in the case of London itself, I submit that these considerations have not such weight. Each £1,000 per mile of additional capital cost would (on the basis of the traffic which I have just mentioned) carry with it capital charges amounting to about $\frac{1}{8}$th of a penny per car mile, from which figure the additional charges corresponding to any probable increase of capital cost per mile can be at once estimated. I do not think they should be such as to prevent you from carrying out an underground system, which would, I believe, be permanently satisfactory to Londoners and worthy of the city and its governing body.

I should add finally that if it should be decided to carry out the long extensions to the south of London on an overhead system, there is no difficulty in arranging the cars so that they can run from underground to overhead and *vice versâ*, either with no stoppage at all at the point of change, or with a stoppage of only a few seconds.

I remain, your obedient servant,

ALEX. B. W. KENNEDY.

A NEW WHEATSTONE BRIDGE.

THE form of Wheatstone bridge shown by fig. 1 is a pattern which is being manufactured by the Scientific Instrument Company, Limited, of Cambridge, and patented by Prof. H. L. Callendar, F.R.S., and Mr. E. H. Griffiths, F.R.S. It is specially adapted for the measurement of low resistances, and was designed to get rid of some of the sources of error met with in the ordinary form of bridge.

The arrangement consists of a wooden base on which are mounted seven porcelain plug holders, also bridge and galvanometer wires of platinum silver, and the necessary terminals for battery and galvanometer connections, &c. One end of the bridge wire is held by a brass spring, the tension of which can be adjusted in order to take up any looseness in the stretched wire due to shrinkage of the wooden base or to the lengthening of the wires due to change of temperature. This brass spring is adjusted by means of a screw set midway between the fixed end of the spring and the end to which the bridge wire is connected.

Connection is made between the galvanometer and bridge wire by means of a simple but effective contact maker. This consists of a small felt-padded ebonite button placed on a steel spring. This is pressed on to the bridge and galvanometer wires, which are in their turn depressed on to a small piece of platinum silver wire set at right angles to them, and fixed on to the sliding piece which carries the vernier, thus completing the galvanometer circuit. It has been found in practice that this form of contact maker does not damage the bridge wire to the same extent as the old form of contact, in which the contact piece was pressed direct on to the wires. Moreover, any shake or uncertainty which may occur when the contact piece is movable is avoided. Again, tension in the wires also tends to break the contact as soon as the spring is released. The carrier runs between guides in which it is held by means of a weak spring. The galvanometer circuit can be kept closed by means of a small clamp screw mounted on the contact maker.

Stout rods are used for connecting the bridge wire to the coils and

to the leads, so that this resistance is small compared to that of the coils. These coils, which are made of platinum silver, are wound loosely in small hanks, and are suspended in air from the end of their connecting rods, set in a box at the back of the base board. The coils are seven in number, and are each put in circuit by removing a plug. Every plug contact is made in a porcelain pot, in which is cast a special fusible metal into which the plug is fitted, the contact surface of the latter being 3 centimetres in length, and so made that when in position the top part of its taper is below the upper surface of the fusible metal, thus avoiding a shoulder being worn on the cone of the plug, and ensuring a perfect contact. It will also be seen that each contact being independent of its neighbour, the withdrawal or inser-

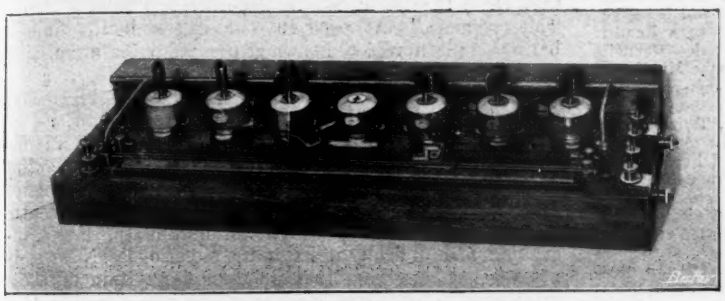


Fig. 1.

tion of a plug does not disturb the contact of either of its fellows, even if the plugs are pressed in with great force. The copper leads which join the coils to the plug blocks are specially designed to avoid any alteration in the length of copper being made when one or all the coils are in or out of circuit. This is effected by an ingenious device due to Mr. Horace Darwin. The copper connections are made in the form of the letter X, being fixed together where the lines intersect, thus leaving four equal arms. The front two are cast directly into the fusible metal sides of two consecutive plug pieces, one arm being attached to the right hand portion of the left hand plug hole and the other to the left hand half of the right plug contact. The back arms are connected to the ends of two consecutive coils. Fig. 2 fully explains this:—

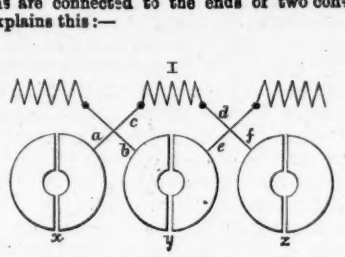


Fig. 2.

x, y, and z are three plug blocks, connected by the copper rod a, b, c, d, e, f, which form equal quarters of the X connections. Supposing the plug is removed from y in order to put the coil I in circuit, then the length of copper connection in circuit is equal to f, d, c, a, but should this plug be in, then we have an equal length of copper in circuit in the sections f, e, and b, a.

The coils are arranged in the form of a binary scale with 10 units as the lowest coil, and taken to the sixth double of this coil, viz., 10, 20, 40, 80, 160, 320, and 640. Each coil has a corresponding letter, B, C, D, E, F, G, and H, it having been found that this lettering frequently prevents errors in the entering of observations. Moreover, as any one low resistance can only be made up by the combina-

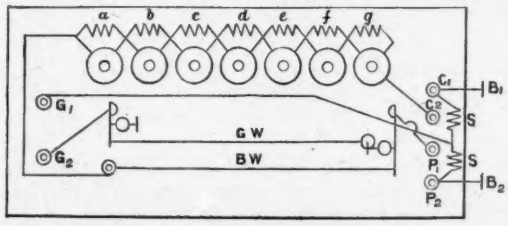


Fig. 3.

tion of certain definite resistances, it is possible to re-check the corrections to the coils with a degree of accuracy unobtainable in a box in which the coils are numbered 5, 10, 15, 20, &c., as a resistance in the latter box may be made up by two or three combinations of resistances. As the box is essentially one for low resistance work the unit is taken as one hundredth part of one ohm, so that coil H (640 units), is in reality 6·4 true ohms. The bridge arms are adjusted to exactly the same resistance, viz., 10 ohms (1,000 units), and being wound together and embedded in paraffin wax, any change in temperature affects both arms equally.

The arrangement of equal arms greatly facilitates the measurement of any resistance, as when G is balanced and the scale reading taken, then in order to obtain the true resistance at x, it is only necessary to subtract or add the bridge wire reading to that of the plugs (according as the reading is to the left or right of the zero point on the scale). The box is so arranged that the reading on the scale is subtracted from the plug resistance when the balance point is to the left of zero, and added when to the right. The scale is divided into millimetres, a centimetre on the bridge wire being approximately equal to one box unit.

The method of compensating for the external leads is, perhaps, the most important improvement in this box, and deserves special notice. These leads are not made up in a pair, as is generally the case, but consist of a stranded conductor composed of four stout flexible leads carefully interwoven with one another. Two of these leads are connected to the resistance to be measured, and the other two, which are short circuited near the resistance, are placed in the opposite arms of the bridge. Thus any changes in the resistance of the leads, owing to differences in temperature, are compensated for, and no corrections have to be made on the score of leads. The leads have copper lugs soldered at each end after they have been adjusted for equality. Thus with the most ordinary care there is no danger of this equality altering. The true zero point on the bridge wire can readily be determined by short circuiting these two pairs of leads.

Fig. 3 is a general diagram of the bridge.

Everything being compensated for in the way described, a high degree of accuracy may be attained, and though the bridge, fig. 1, is styled a "student's bridge," yet it is, when carefully calibrated, capable of doing really excellent general work. It can be tested and calibrated on itself, as the value of the coils can be found in terms of one another by a method, details of which are supplied with each instrument. It is thus only necessary to know the value of one coil in true ohms to be able to obtain the absolute calibration of the whole apparatus.

The above is only one pattern of this special bridge. More elaborate designs have been completed, with which some of the finest possible resistance work ever attempted has been accomplished. Among other improvements the coils consist of bare platinum-silver wire wound on mica frames and immersed in a high insulating oil. The oil bath is fitted with stirrers, and it is possible to determine the temperature of the coils with a much higher degree of accuracy than if they were embedded in solid paraffin.

An excellent type of this box may be seen in the physical section of the South Kensington Museum.

LIGHT ELECTRIC RAILWAYS IN MIDDLESEX.

Proposals to Gradually Link up the County by Means of a Network of Lines.

The Middlesex County Council is jealous, and justly so, of the independence of its own county, and when the London County Council recently suggested the appointment of a joint committee of the two bodies "to consider and deal with all matters relative to the promotion and carrying into effect of light railway schemes affecting both Councils," the astute members of the former body thought there was an insidious movement behind the proposal. There was no doubt on the matter. The London Council thought, or at least the Highways Committee were under the impression, that it was the desire of the Middlesex Council that the two bodies should act in unison in settling and promoting schemes for light railways to be constructed in Middlesex in connection with the tramways in London, with a view to ultimately coming to some arrangement as to the method under which such light railways should be administered after their construction.

This impression, which was founded on an erroneous basis, was dispelled by Sir Richard Nicholson, clerk of the Middlesex Council, who informed the London Council that it was impossible to understand how it could be imagined that Middlesex would act in any way in conjunction with London, except upon the distinct understanding that each county council should be the light railway authority in its own county. Sir Richard added that the County Council would not reverse its avowed policy from the commencement "of admitting no interference from any outside authority in its county." This statement places the whole matter in a nutshell. London wanted to unwarrantably interfere in Middlesex, but London was not sufficiently conscientious as to ask Middlesex in return to interfere in the metropolitan area. It would at once have cried, "Hands off!" if the suggestion had been made. The Middlesex County Council is, however, ready to enter into negotiations for an interchange of traffic between the two counties. What more does the L.C.C. want? In a moment of pique at this rebuff the L.C.C. resolved to support one of the District Councils in opposing a light railway scheme projected by the Middlesex County Council. It will be interesting to learn what the Light Railway Commissioners will have to say on the unseemly attitude of the L.C.C. in this respect when the local inquiry takes place.

In the meantime it should be mentioned in connection with the 21 light electric railway schemes proposed by the Middlesex County Council, that Mr. James Bigwood, M.P., the chairman of the Parliamentary Committee, has been authorised to obtain the advice of an electrical engineer, in addition to that of Mr. Wakelam, the county engineer and surveyor, in the elaboration of the schemes. The latter gentleman has also been directed to prepare the necessary plans and sections and books of reference for deposit with the Light Railway Commissioners.

Of the 21 light electric railways proposed for Middlesex, the County Council has decided to apply to the Light Railway Commissioners, in conjunction with the Metropolitan Tramways and Omnibus Company, for a provisional order to construct 10 of these lines, these being included in the Middlesex Light Railways Order, of which public notice has already been given. One scheme relates to a line in Friern Barnet and Finchley, which the former District Council suggests should be substituted for a section included in the Middlesex order; four others refer to a line from Harlesden, through Wembley, Harrow-on-the-Hill, and Wealdstone to the foot of Stanmore Hill; whilst the remaining six proposals affect Isleworth, Twickenham, Teddington, Hampton, and Hampton Wick. It may be remembered that the London United Tramways Company promoted lines in the latter parishes, but the Light Railway Commissioners declined to grant the desired order.

In conclusion, it should be mentioned that the object aimed at by the Middlesex County Council is the gradual construction of a network of light electric railways throughout the county, so as to link up the most important districts and at the same time afford a connection with the London tramway system. The only serious difficulties likely to be encountered are those put forth by some of the district councils, who not unnaturally desire to be considered in regard to the proposed routes, terms of lease, and other matters. These points are receiving the attention of the Middlesex County Council, and it is hoped that all obstacles will shortly be overcome. The hostile attitude of the L.C.C. can hardly be expected to in any way affect the ultimate result; it cannot possibly have any *locus standi* in Middlesex, which intends to preserve its independence, whilst at the same time being prepared to discuss ways and means for an interchange of traffic at the boundary lines of the two counties.

REVIEWS.

The Value of Electrical Treatment. By Julius Althaus, M.D., M.R.C.P. Lond., M.R.I. Third edition. Longmans, Green & Co., London, New York, and Bombay.

In 1873 Dr. Althaus published "Medical Electricity," a work which, from the medical standpoint at least, seems to have been more than abreast of its time. In 1895 there appeared the first edition of the volume now under notice, and it was a matter of comment at the time that it contained no adequate recognition of the great progress in electro-therapeutics that had been made in the long interval since 1873. For example, sinusoidal currents, high frequency currents, and the methods of Apostoli were noticeable only by their absence, although these procedures were at the time very generally known. "Metallic electrolysis" was not mentioned, and the short notice of cataphoresis that did appear, by no means atoned for the opinion expressed in the volume of 1873 (p. 708) that the view that "electricity may serve to introduce drugs into the system is likewise untenable." We are glad to see that in the present edition the above-named gaps are to some extent filled in, and that the writer, profiting perhaps by criticism on his first edition, now notices a certain portion, at least, of what he condescends to call "the quiet and useful work" that has been done since 1873. There is even a chapter on current from the main, a title which might almost have been put in inverted commas, as it is now many years ago (1891) that a writer in the *Lancet* first drew attention to this subject under this title, and has continued to do so at intervals ever since.

In this connection it may be incidentally mentioned that it was not until after the publication of one of these articles that the instrument maker referred to by Dr. Althaus introduced the shunt principle into his rheostats.

Of all the forms of electricity for medical purposes, Dr. Althaus still maintains, and doubtless with excellent reason, his unswerving allegiance to "the battery." Indeed, in describing electrical energy in its more modern forms, although he deals with these at some length, his descriptions fall far short of impressing the reader with the idea that he has actually handled these currents himself, or that even he quite apprehends what is known of their phenomena. Speaking of currents of great frequency and high potential, by means of which intensities may be passed through the body, which at a lower frequency might be fatal, he recognises an analagous fact in the spheroidal condition of bodies; for example, in molten metal at white heat not injuring the hand plunged into it, whereas only at a red heat serious injuries would follow. Those of his readers who understand the physics of the phenomena in question, may perhaps be excused if they fail to see the force of such an analogy.

It is not our province to criticise the medical part of this book; we can only regard its curative achievements with feelings of wonder and praise, and also with a consolation akin to that which the devout believer finds in the "blessed" word "Mesopotamia." At page 49 we learn that in the human brain there is a region known as the "anterior association centre." It is this centre "which directs our actions, enables us to judge our own conduct, and tells us what is right and what is wrong. It therefore constitutes the δαιμονίον (the divine warning voice), of which Socrates speaks in Plato's Euthyphron. Disease of this centre changes the perception of the Ego as an active being, and diminishes or annihilates personal initiative." A disordered condition of this centre appears in "deficient self-control, diminished initiative, indecision, and difficulty in fixing the attention." Now it is not without misgiving that we recognise certain of these symptoms in ourselves, and even in our friends. Our wandering thoughts on these summer days point to a "difficulty in fixing the attention," and certain unsatisfactory transactions with city friends can only be explained by an unfortunate disability (on their part) to "distinguish between what is right and what is wrong." It is only too evident that things are not quite as they ought to be with our respective "anterior association centres," and it is no small relief to find that all this, serious as it is, may be set right by a trifling expenditure of $\frac{2}{10}$ths of a milliampere of continuous current from the head to the hand, applied according to the author's methods.

A little further on (p. 60) we find that "our mean lifetime is at present about 50 years, but the complete cycle of physiological life to which we ought all to aspire is 100," and it is with feelings of gratitude we note that we can be helped on towards attaining our "century" by a cautious use of continuous current to the brain—according to the author's methods. "A week or two after the commencement of such a treatment the energy of the system is habitually found to have been considerably enhanced. The old man takes fresh interest in the affairs of daily life . . . . his peevish and querulous temper is no longer a source of trouble to his friends. . . . . Quite recently a veteran actor who delighted the last generation by his magnificent Shakespearian performances, told me after a few applications, 'I no longer crawl but walk;' and a composer of music, of advanced age and bowed down by many infirmities, volunteered the remark, 'I no longer walk but fly.'" The "Value of Electrical Treatment" is surely no adequate name for such a book as this. "The miracles of medical electricity" would in our opinion be a title none too strong. At least one thing seems clear. Could a certain eminent "electrician," who so long adorned a conspicuous corner in Oxford Street, once more return to the scene of his labours and success, it would only be to find that in comparison with the achievements of the legitimate practitioner, he is no longer "in it."

Pocket Book of Useful Formulæ and Memoranda. By Sir Guildford L. Molesworth and Henry Bridges Molesworth. 24th edition. London: E. and F. N. Spon, Limited, 125, Strand.

In the preface to this issue we are informed that neither has labour been stinted nor counsel disregarded in order to render the 24th edition worthy of its predecessors.

The electrical portion of previous editions was struck out of the 23rd edition, as it was the intention of the authors to have published a separate electrical pocket-book. For reasons which it is unnecessary to state, that intention has been abandoned, and an entirely new electrical section has been now added to the 24th edition.

It is somewhat to be regretted that the authors' intention of publishing a separate electrical edition was not carried out, not, however, from the view of the possibility of such an electrical edition proving a valuable compilation, but from the fact that it would have relieved the present issue from

what can only be characterised as a very unsatisfactory production. Not only is a large amount of the matter included of an unpractical nature, and almost useless to the practical engineer, but we come across such an astonishing display of errors as one could hardly credit. Turn, for example, to page 787; we should have thought that every schoolboy knew what a submarine cable was like, yet here we have the most remarkable "Typical Submarine Cable" that was ever devised, and we are constrained to ask, Was it inserted as a joke or in sober earnest? First we have the "conductor" which the author calls the "core," then the gutta-percha insulation, next a "composition," then a "lead sheath"!!!; next hemp, then the armouring, such as was never seen yet on a submarine cable, and finally the hemp serving. The figures illustrating insulators must have been devised from the author's inner consciousness, as such patterns are never seen in practical use. Also the "Telegraph Poles" illustrated are a curious combination of wood and iron. Then we have "Lightning Arresters," "a pile of metallic discs separated by laminæ of mica . . . . the top disc connected with the line, and the bottom disc to the earth." It is a pity that an illustration is not given of this "pile of metallic discs." Next we have "Duplex Telegraphy," in which we are told that "the *current* from line is neutralised by that from the condenser." The description of the differential duplex is also a marvellous display, either of want of knowledge or lack of descriptive power. On page 740 we have a brief table showing "Best Resistance and Deflection for Telegraph Cells," a table which, in the absence of constants, is just as valuable as the dimensional "lump of chalk" of tradition, let alone the fact that the figures given could only be for special cases, and are of no general value whatever. On page 783 we are told, with reference to "Test in Laying Cables," "Leakage is indicated by a *fall* in the deflection of the ship's galvanometer." The "Electrostatic Capacity" test (De Sauty's) which follows, and which is the only one given, is the most unreliable one that could have been selected.

The pages are plentifully bestrewn with matter by H. E. Harrison, which matter, although doubtless perfectly correct, is not generally of a description suitable for practical engineers. Page 752 contains the well-known illustrations of types of winding the field magnets of dynamos. The repetition of these illustrations in every class of engineers' pocket or handbooks is often sneered at by critics, but we maintain that they are very much in place, and should by no means be omitted. Such matter as this, and that on the following two or three pages, is distinctly useful, and if the whole electrical section had been compiled on such lines it would have been of considerable value. In the pages following where Messrs. Harrison and Russell appear, the want of discretion in the selection of matter becomes apparent. We venture to say that the omission of such matter would be a gain rather than a loss. On page 756, a frequency of 16½ is given as the best for utilising continuous current dynamos for synchronizing motors!—and an absurd diagram of a projector arc occurs on page 786. Such diagrams as that given on page 765, showing the "increase per cent. in the resistance of hard copper with increase of temperature," are much better dispensed with, and a short table of numerical values and a formula given instead. Graphic representation is all very well, but it has been, in our opinion, very much overdone. It often seems to be forgotten also that a series of curves which, drawn on a large scale, are of value, become practically useless when reduced to pocket-book size.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1899.

Compiled expressly for this journal by W. P. THOMPSON & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, to whom all inquiries should be addressed.

15,644. "Electrical ignition apparatus." F. KUPPER. Dated July 31st.

15,669. "Improvements in governing devices in connection with fluid pressure engines in combination with dynamo-electric machines and other machinery which requires accurate governing." R. P. ISAACSON. Dated July 31st.

15,677. "Improvements in supports for galvanometers and other delicate instruments." J. H. MAY. Dated August 1st.

15,699. "Electric fuse outfit." H. E. DAVIS. Dated August 1st.

15,705. "Improvements in or relating to electric meters." J. H. BARKER and J. A. EWING. Dated August 1st.

15,717. "Improvements in fusible cut-outs." THE BRITISH THOMSON-HOUSTON COMPANY, LIMITED, and E. B. WEDMORE. Dated August 1st.

15,720. "Improvements in electric arc lamps." CROMPTON & CO., LIMITED, A. J. HODGSON, and C. F. TUBBS. Dated August 1st.

15,744. "Improvements in or connected with electric regulating switches." O. D. LUCAS. Dated August 1st.

15,807. "Improvements relating to the terminals of electric batteries and the like." A. C. WRIGHT. Dated August 2nd.

15,816. "Improvements in electro-magnetic rail brakes." A. WILDE. Dated August 2nd.

15,882. "Improvements in apparatus for operating two or more electrical regulating switches or resistance devices together or separately." O. D. LUCAS. Dated August 3rd.

15,904. "Improvements in and connected with transformer boxes." A. J. LAWSON, J. D. DALLAS, and E. T. GOSLIN. Dated August 3rd.

15,911. "Improvements in or relating to electro-magnetic apparatus." W. F. JONES. Dated August 3rd.

15,967. "Improvements in electric arc projecting lanterns." L. KAMM. Dated August 4th.

15,973. "Improvements in and relating to the direct coupling or connection of rotary fans or pumps with electric or other motors or engines driving same." S. C. DAVIDSON. Dated August 4th.

16,005. "Improvements in the method of and apparatus for manufacturing incandescent electric lamps." A. SWAN. Dated August 5th. (Complete.)

16,040. "Improvements in electric fuses and electric detonator fuses." G. SMITH and D. CORRIE. Dated August 5th.

16,055. "Improvements in electric switches." W. F. JONES. Dated August 5th.

16,062. "Improvements in or connected with electric light fittings." H. H. COOPER. Dated August 5th.

16,083. "Improvements in controlling devices for electric currents." H. CUENOD. Dated August 5th.

16,091. "Improvements in electrical apparatus suitable for lighting, cauterizing and other purposes." J. RICHARDSON and H. RAMSBOTTOM. Dated August 5th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. THOMPSON and Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, price, post free, 9d. (in stamps).

1897.

12,639. "Improvements in means for regulating the voltage of dynamos." La Societe Generale des Industries Economiques. Dated May 21st, 1897. (Date applied for under Patents, &c., Act, 1883, Section 103, March 20th, 1897, being date of application in United States.) In order to regulate the voltage of dynamos driven by explosion engines and other motors, the speed of which varies in different portions of the cycle, a series of resistances is placed in the field circuit, and these are increased or decreased automatically as the speed of the motor varies. A suitable form of apparatus comprises a collector, having a series of contacts connected through resistances to a contact ring, and a brush holder carrying brushes, bearing on the circle of contacts and the contact ring respectively. Either the brush holder or the collector may be fixed to the motor shaft so as to rotate it. The contacts are so spaced and the resistances so graduated as to exactly compensate for the fluctuations of speed of the motor; the arrangement shown is that employed for a four-stroke cycle explosion motor. 2 claims.

12,642. "Improvements in contact fingers for electric controllers." E. C. Parham. Dated May 21st, 1897. (Date applied for under Patents, &c., Act, 1883, Sec. 103, November 18th, 1896, being date of application in United States.) The contact fingers of controllers are formed of magnetisable metal, and are so arranged as to produce an electro-magnet which will blow out an arc, if formed, on breaking contact. The contacts engaging with the contacts on the drum are carried by forks secured to the springs connected to the base. The forks thus form electromagnets and tend to blow out any arc which may be formed when contact is broken. In a modified form, a single arm is employed in place of the fork, and the magnetic circuit is completed through suitably arranged bars. 15 claims.

12,643. "An improved system of conductors for electric railways." E. Lachmann. Dated May 21st, 1897. Electric railways and tramways on a three-wire system. The exposed conductors on which the collectors run, here shown on the overhead system, are alternately positive and negative, and the non-exposed portions are placed alongside. The current is picked up by a number of collectors and between them and the motors on the vehicle an automatic reversing switch is placed to maintain a uniform direction for the current to the motors. This consists of a rocking arm for each collector working over two pairs of contacts and operated by a magnet acting on the coils, which are included in the circuit from the collectors so as to be attracted alternately according to the current. In case of alternating currents this switch is unnecessary. 2 claims.

12,665. "The combined generation and application of electricity supply and the manufacture of salt." H. Tee. Dated May 22nd, 1897. Brine is concentrated in a closed vessel from which salt is removed by rotary scrapers, while steam is generated under pressure to drive condensing engines connected to dynamo electric generators; the current from these may be employed for making calcium in electric furnaces, or other purposes. The concentrating apparatus may be heated by the exhaust steam of high pressure engines, which also operate electric generators, or by gaseous or other fuel. Specifications No. 6,565 and 6,565A, A.D. 1895, are referred to. The brine is contained in vessels having conical roofs and bottoms connected by central openings, and supported by walls which form heating flues under the bottoms. A vertical central shaft carries scrapers. The apparatus is closed at the top by a steam dome, and at the bottom communicates by a valve with a receptacle for the salt; this can be removed by another valve when the valve is closed. Similar apparatus, but with flat floors and roofs separated by steam spaces, is used for concentrating by exhaust steam. In a modified arrangement a single vessel only is used, or two such vessels are placed side by side with one continuous heating flue. The floor in such apparatus may be flat or rise to the centre, and salt receptacles may be provided at the side; a flat door may be stayed to bottom plates, enclosing space for the heating gas, the stays being protected by cast-iron tubes. The scraper shaft may be tubular, to enclose a central vertical stay. 10 claims.

12,910. "Improvements in telephone receiver supports." L. Duque and F. McClelland Cosgrove. Dated May 25th, 1897. Consists of a support for a telephone receiver for holding it in a convenient position near the head of the user. The receiver rests in a cage or basket with two screw sockets, either of which may be screwed to the end of a rod, which slides in a tube, fixed by a hinge-point in the horizontal arm of a bracket attached to the wall, &c. A clamping screw holds the tube in any angular position, and the rod is fixed by a screw. A weight may be hung from the receiver hook when it is desired to keep the receiver in the basket while calling. 1 claim.

12,974. "Improvements in electrical telegraph systems and apparatus therefor." H. H. Lake. (C. G. Burke, United States.) Dated May 26th, 1897. In receiving instruments used on submarine or other long lines for recording Morse or similar signals, the magnet is caused by suitable electric impulses to make a continuous mark in the absence of line current, so that the code signals are indicated by breaks in the line recorded. The signals are sent by a hand-key, or preferably automatically by tape prepared in a special instrument. In order to indicate the spaces between letters and words, long breaks are made in the record, or the last signal of the code for any latter is lengthened or duplicated at a very short distance. A pole changer consisting of a pivoted forked lever working on a tapering or wedge-shaped contact, and operated from the armature of a relay magnet, is used for "clearing" the line; by this special form of contact the duration of the clearing current can be regulated as desired. Similarly the perforations in the tape are made triangular in shape, so that, by shifting the tape transversely in the transmitter, the length of contact for dots and dashes may also be regulated. The apparatus for preparing the tape is fitted with two keys for the dot and dash respectively, and with suitable spacing keys. When a key is depressed, a contact is made which closes the circuit through the punching magnet; a contact on the armature lever of this magnet closes a relay circuit when a key has been depressed, and by means of pawl and ratchet mechanism causes a feed of the paper strip. The separate keys are arranged to give differential spacing. When the instrument is to be worked by persons ignorant of the code, the keys are depressed by magnets in circuits controlled by contacts operated from alphabetical keys. 8 claims.

26,656. "Improvements in and relating to electric accumulator plates." P. F. Ribbe. Dated November 15th, 1897. The plates or electrodes consist of a flat plate of lead with a thickened rim, and vertical rows of perforations covered on each side with celluloid strips, which are united to each other by celluloid solutions through the perforations. The strips have undercut edges which hold the active material in place. The whole is covered by thin plates of celluloid in which are many apertures. 1 claim.

26,657. "An improved device for guiding the carbons in electric arc lamps." R. W. L. Holsten and the Electrische Bogenlampenfabrik Naeck and Holsten Gesellschaft mit beschrankter Haftung. Dated November 15th, 1897. Relates to arc lamps.—The carbons in a focussing lamp are carried by movable holders and are guided near the arc by a thin cross bar and a mica plate secured on an enamelled reflecting disc, these parts being carried by clips adjustable on the side rods of the lamp. The arrangement permits thin carbons to be used. 1 claim.

26,659. "An improved automatic cut-out or short-circuiting device for electric arc lamps." R. W. L. Holsten and the Elektrische Bogenlampenfabrik Naeck and Holsten Gesellschaft mit beschrankter Haftung. Dated November 15th, 1897. Relates to means for short-circuiting a lamp should the arc in the lamp fail. The electro-magnet which regulates the arc acts on an armature fitted with a platinum contact and connected to one of the terminals. An electro-magnet and resistance are connected to the other terminal. In normal working, the contact does not touch the contact of the electro-magnet, but, should the arc fail, the armature is more strongly attracted and makes contact, so completing a circuit through the resistance. When the carbons once more approach, the current through the magnet is short-circuited and the armature falls away. 1 claim.

26,671. "Improvements in or relating to electrical indicating apparatus for use in hotels, restaurants, workshops, and for analogous purposes." A. J. Boult. (H. Montardier and L. Boudet, France.) Dated November 15th, 1897. Relates to an electric indicating apparatus or order telegraph for use in hotels, restaurants, workshops, &c. The transmitter is provided with two dials, one having interchangeable plates marked with the names of the articles, &c., which may be asked for, and the second being adapted to show the number of each article required. Two hands, fixed on the spindle and sleeve respectively, are capable of being moved over the dials, and the spindle and sleeve are each provided with a toothed wheel adapted to rotate the contact-making ratchet wheels through the pinions. The ratchet wheels each consist of a metal half and an insulating half, which are arranged so that the contact springs of the leads to the receiver alternately bear on a conducting part and an insulating part. The receiver is provided with two dials and hands corresponding to those of the transmitter, the hands being each operated by a clockwork mechanism, the escapement of which is controlled by an electro-magnet energised by the current from the transmitter. Only two connecting wires are employed, each transmitter and receiver having a local battery, the negative pole of which is connected, conveniently through a gas pipe or water pipe, to earth. In operation, the operator at the transmitter presses a call-knob, which completes the circuit of a drop-down annunciator at the receiver, indicating the number of the room from which the call is made, &c. The annunciator shutter, when it falls, completes the call-bell circuit. On receiving the call, the attendant at the receiver inserts a contact plug or jack in a socket corresponding to the number shown, so disconnecting the annunciator circuit, and, by pressing a push, makes the reply call. The operator at the transmitter then moves the hands over the dials until they point to the required indications, the hands of the receiver following step by step the movements of the hands of the transmitter. The hands of the receiver are re-set to zero by a bar, which disengages both escapement levers simultaneously, and so permits the movement of the hands until they are checked by a stop-finger at the zero point. 4 claims.

26,680. "Improvements in electric accumulators or storage batteries." A. Tribelhorn. Dated November 15th, 1897. The electrodes are made of a cup-like shape in order to form a receptacle for the electrolyte. The active material is spread on the upper and lower surfaces of the receptacle, or may be in the form of rods or bars projecting upwardly and downwardly from the receptacle. The electrodes are arranged in tiers as shown, insulators being placed between each pair of electrodes, and the electrodes may fit closely together so as to form a sealed battery provided with suitable gas exits. 1 claim.

26,682. "Improvements in electro-medical and exercising apparatus." W. A. Webb. Dated Nov. 15th, 1897. (Date applied for under Patents, &c., 1883, Act, Sec. 103, June 2nd, 1897, being date of application in United States.) Relates to a pair of dumb-bells, Indian clubs, &c., used in connection with an induction coil and a battery, for electro-medical and exercising apparatus. A dumb-bell connected by insulated wires to the induction coil having a contact-breaker, and enclosed in a casing which rests on the chest is shown. The insulated wires leading therefrom pass over the shoulders, and carry at their other ends, resting on the back, any suitable dry battery enclosed in a casing. The coil is arranged in an eccentrically-arranged recess of the casing having wires leading to the battery, and a vibrating contact-breaker in a recess closed by a sliding-cover. Each bell has a metallic tubular handle connected to hemispherical metal ends, the latter being connected together by a screwed rod passing through the whole bell. The handles are provided with binding-screws for connecting up the bells with the induction coil. Small spring bolts are arranged beneath slits or openings in the adjoining edges of the hemispheres, whereby metal discs or coins may be forced into the heads to increase the weight as required. 7 claims.

26,727. "Improvements in electric brakes for cars." O. J. Menzies and J. A. Bell. Dated November 17th, 1897. Relates to electric brakes.—An electro-magnet is secured to the axle upon which the armature is loosely mounted and connected by a chain to the pivoted lever for operating the brake beams. The electromagnet, which consists of a number of coils in series arranged around the hub, when energised attracts the armature and thus produces a resistance to the movement of the latter on the car axle, thereby winding up the chain and applying the brakes. 6 claims.

26,728. "Improvements in and connected with alternating electric current electric motors." W. L. Wise. (A. J. Churchward, United States.) Dated November 17th, 1897. Relates to the construction and mode of operation of a single-phase self-starting alternating-current motor, combining in one machine the principle of an alternating current synchronous motor, with that of the ordinary continuous current motor used for non-synchronous or starting purposes. The motor is arranged so as to operate first as a non-synchronous motor, and after attaining the requisite speed, it is converted by suitable switch mechanism into a synchronous motor. An application of the invention in its simplest form to a bipolar motor comprising an ordinary continuous current armature with its commutator, and a field magnet, the poles of which are each wound with a shunt coil and a series coil is shown. Upon the armature shaft are also mounted two slip rings and a rectifying commutator, and the various parts are connected as shown with two series of terminals, which in conjunction with a pivoted switch bar, carrying suitably disposed contact plates, enable the connections to be changed from those necessary for non-synchronous to those necessary for synchronous running. In star ing the motor, the switch bar is depressed so as to close the contacts; the field circuit is now in series with the armature, and both carry an alternating current. When the motor has run up to synchronism, the bar is raised so as to close the contacts; the field circuit is again in series with the armature, but it is now supplied with a continuous current through the rectifying commutator; at the same time the shunt circuit is closed, and the motor runs as a synchronous motor. A self-induction coil, or a condenser, is arranged as a shunt across the brushes of the commutator so as to equalise the current in the field circuit. For efficiently starting the motor, a regulating coil wound on a circular core is placed across the mains. The switch bar may be operated by hand or it may be operated automatically by means of a centrifugal governor, and the switch arm of the regulating coil may be operated simultaneously by the same mechanism. Means are also provided for retaining the bar in either of its two positions and for automatically releasing it, by the action of the two electromagnets, when the motor attains the synchronous speed or falls below it. The lead of the commutator brushes may also be automatically varied by the switch mechanism, so as to avoid sparking. 18 claims.

26,732. "Improvement in or relating to systems of electrical distribution." L. Andrews. Dated November 17th, 1897. Relates to systems in which current is supplied from a central generating station to sub-stations or distributing plant, and consists in arranging magnetic cut-outs on the feeders, so that should one fail and the current be reversed, then that feeder would be cut out. An electro-magnet is arranged in series with the feeder to be controlled, and its pivoted armature is wound with a coil connected to the working circuit. In normal working, that is, as long as the feeder supplies energy to the system, the armature tends to rotate clockwise, but is prevented by a stop. In this position it supports the weighted arm of a switch. Should the feeder under abnormal conditions absorb energy, the armature rotates in the opposite direction and releases the arm. The construction of the cut-out is described in specification No. 3,496, A.D. 1898. 2 claims.

26,733. "Improvements in magnetic cut-out apparatus." L. Andrews. Dated November 17th, 1897. Relates to a magnetic cut-out for cutting out an outgoing lead should the generator fail. Generators connected in parallel to the conductors are shown, also a switch which is operated automatically to break the circuit should the generator fail, and be driven as a motor or otherwise. A field-magnet is in series with one of the leads, and its rotary armature core is provided with a shunt winding. The end of the armature is a catch supporting the weighted arm of the switch. Normally the armature tends to rotate clockwise, but is held by a stop. On reversal of the current it rotates in the opposite direction and releases the arm. 1 claim.

26,752. "Improvements in flexible conduits for electrical conductors." E. T. Greenfield. Dated November 16th, 1897. Flexible conduits are formed by alternating layers of rubber or other flexible insulating material strips. The inner layer forms a closed spiral, or may be a complete tube, while the outer layers form open spirals which break joint throughout. In the form shown the outer layer is corrugated centrally so as to force the underlying rubber between the metal spiral. In another form the inner metal spiral is concave in section and has a central row of projections, the outer layer being convex and having internal cross ridges to form a locking connection. The layers are attached by rubber, &c., cement, and the whole may be vulcanised as desired. 7 claims.

27,598. "Improvements in electrical fusible cut-outs." G. Byng. Dated November 24th, 1897. Electric cut-outs.—In order to minimise the dangers from arcing, the fuse wire is led through a chamber or compartment lined with a refractory material which will not volatise at the high temperature of the arc. The base, cover, &c., may be of china or the like, with suitable partitions covered or lined with plaster of Paris, cement, fireclay, &c. In modifications, the fuse wire is led through a tube or handle suitably lined. 3 claims.

27,619. "Improvements in incandescent electric lamps." R. Nordmann. Dated November 24th, 1897. Incandescent lamps.—The body of a lamp consists partly of a lens attached by fusion. The filament is made of a sinuous form in a plane near the lens. 2 claims.

28,157. "An improved form of relay applicable to pneumatic or electric organs or to other apparatus." R. Hope-Jones. Dated November 30th, 1897. The invention relates to a form of relay applicable to organs and other apparatus where a movement started by hand is completed by electric or pneumatic agency. A wind chest containing air under pressure communicates by a port with a bellows, and by a second port with a second bellows. The ports are controlled by valves on a rod connected by a friction clamp with a key. On depressing the outer end of the key, the first port is opened to the atmosphere, and the second port to a chest. The remainder of the motion of the key is thus effected by the bellows. The movement is reversed by slightly raising the key. 5 claims.

28,159. "Means for use in lighting cars or carriages by electricity and for regulating the current for the same." S. Watkins. (American Railway Electric Light Company, United States.) Dated November 30th, 1897. The generator is carried on the axle of the car, and means are provided for automatically regulating the current and for maintaining its flow constant as to direction though the rotation of the armature be reversed. A bearing sleeve is also described for carrying the armature. The dynamo is enclosed in a casing, and is supported partly by the axle and partly from the undercarriage of the truck, a lug on the frame resting on a spring carried by the pendant. The current is regulated by varying a resistance in the field-magnet circuit, an arm being moved over the contact disc by a ratchet mechanism controlled by an electro-magnet in the main circuit. The coil has a movable core pivoted at the bottom to an arm and normally forced upwards by an adjustable spring. A shaft rotated by worm gearing from the armature carries a crank engaging with a fork on a rocking shaft carrying pawl fingers adapted to engage when in the proper position with one or other of the reversed ratchet-wheels on the shaft of which the contact arm is carried. When the current exceeds the limit, a core with its extension is drawn down, allowing a finger to engage a wheel which causes resistance to be put in the circuit. When, however, the current falls, the core rises under the action of the spring and one of the fingers come into play and cuts out resistance. In order to automatically reduce the action of the spring when the lights are in use, a magnet is included in the circuit, its armature being attached to a lever which is connected at one end to the spring. The current is kept constant as to direction in the external circuit by a rocking reversing switch, which is controlled by means of a sleeve having a helical groove in which works a stud connected to the switch arm. 9 claims.

28,242. "Improvements in or relating to negative plates for secondary batteries." P. J. K. Dujardin. Dated November 30th, 1897. Secondary batteries.—Relates to that class of battery in which the negative electrode is amalgamated zinc, cadmium, or the like, and consists in constructing that electrode so that the mercury shall not be liable to flow from the upper part of the electrode to the lower part. For this purpose the plate is made up of a number of separate strips of zinc or the like, which are suitably mounted and enamelled at their ends. The strips may be made of wire twisted into the form of cables. The electrode may consist of a single plate with a number of horizontal slots in it, and the strips may be twisted into a horizontal position. The electrodes may be made of woven wire fabric, or may be perforated or plited. 3 claims.

28,246. "An improvement in safety electric fuses." H. C. Gover and W. Muller. Dated November 30th, 1897. The base is formed with slots adapted to receive sliding inverted T-pieces carrying the terminals to which the wires are secured. The wires pass in through holes and are secured by screws, and the fuse wire is threaded through a tunnel and secured by screws. Slots are cut in the screw thread, and communicate with a groove which is in communication with the exterior through openings. 3 claims.